The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

March 1944

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Fifty-third Year of Continuous Publication

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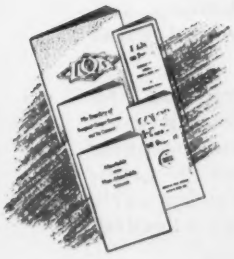

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TO THE SURGICAL PROFESSION

Suture Truths

High-Lighting Factors Essential to Proper Suture Behavior

Catgut chromicized *after* the suture is fabricated, provides:

1. maximal strength during early stages of healing

2. uniform absorption periods for all sizes

There are two basically different methods employed for the chrome tanning of catgut. In one, the strips of gut are pre-tanned before being manufactured into the finished strand. In the other, the strand is fabricated first and then subjected to the chrome tanning process.

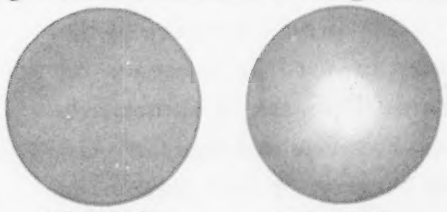
In the pre-tanning method, the various sizes of sutures are made up of similarly tanned material. Therefore, their absorption VARIES according to the diameter of the strand. This means that large size sutures may remain too long in the tissues and small sizes absorb too quickly.

The D & G post-tanning process perfected through more than a third of a century of research and extensive clinical evidence, eliminates this defect in behavior by providing individual treatment of each size. Under this method the finest size is the most thoroughly tanned, the next larger slightly less, and so on—each to the exact degree required to insure proper absorption. Since the process is applied to completed strands of known diameter, it can be controlled with great accuracy to produce sutures of predictable behavior regardless of size.

Another shortcoming of sutures produced from pre-tanned gut derives from the fact that the outer surface is no more thoroughly tanned than the center. Since absorption takes place in proportion to the area exposed to tissue fluids, this means that such sutures lose strength most rapidly in the early stages of healing when the wound is weakest.

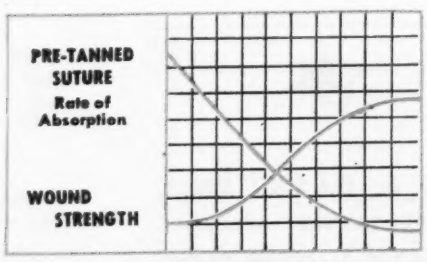
This is exactly opposite to the proper function of a suture which is to RETAIN its maximal strength during the early stages of healing, and then to disappear rapidly as the wound gains strength.

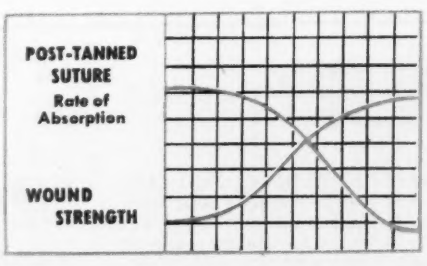
Under the D & G post-tanning method, the outer surface of the strand is tanned to a greater degree than the center. This protects the outer surface from absorption and preserves the original size and strength of the suture during early healing when maximal suture strength is needed.



PRE-TANNED POST-TANNED

By the time the outside of the post-tanned suture is absorbed, healing will be well under way and prompt absorption of the suture desirable.





The curves demonstrate how the pre-tanned suture loses strength rapidly in early stages of wound-healing, whereas the post-tanned suture retains maximal strength during this period when strength is most needed.

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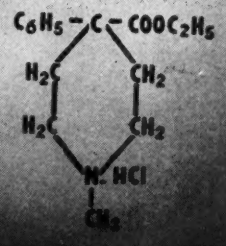

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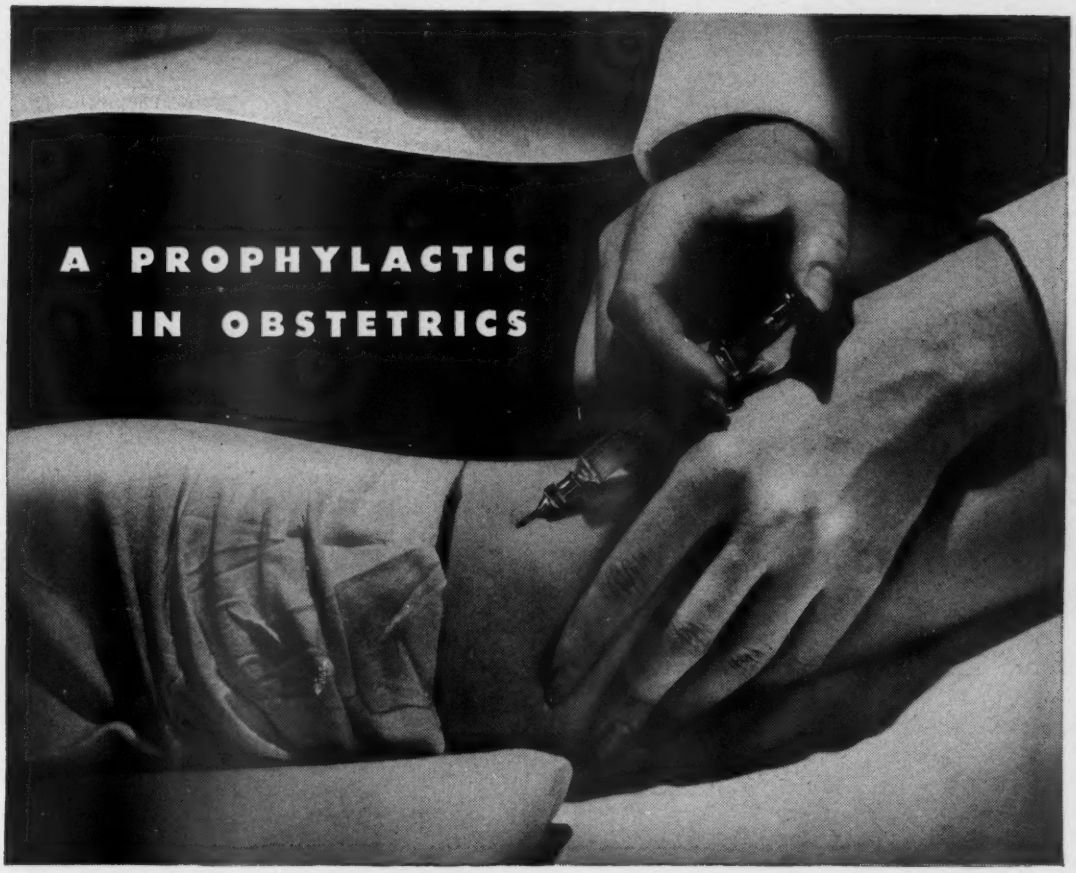

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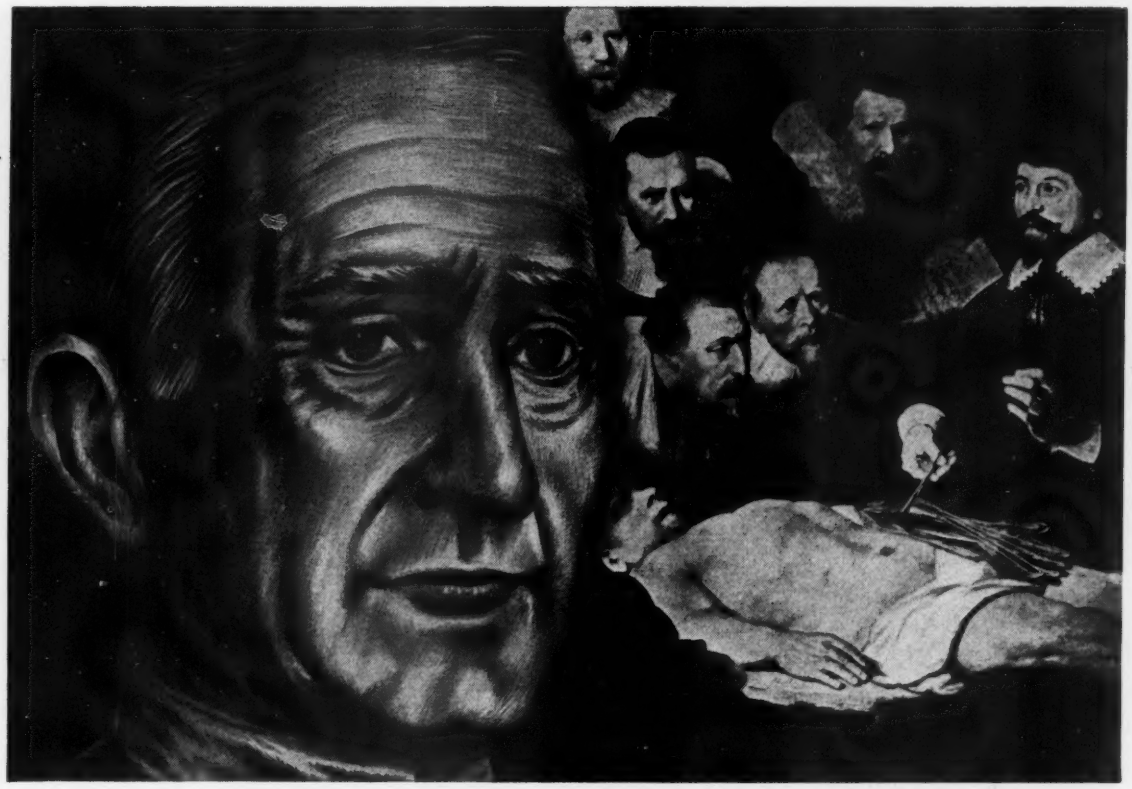

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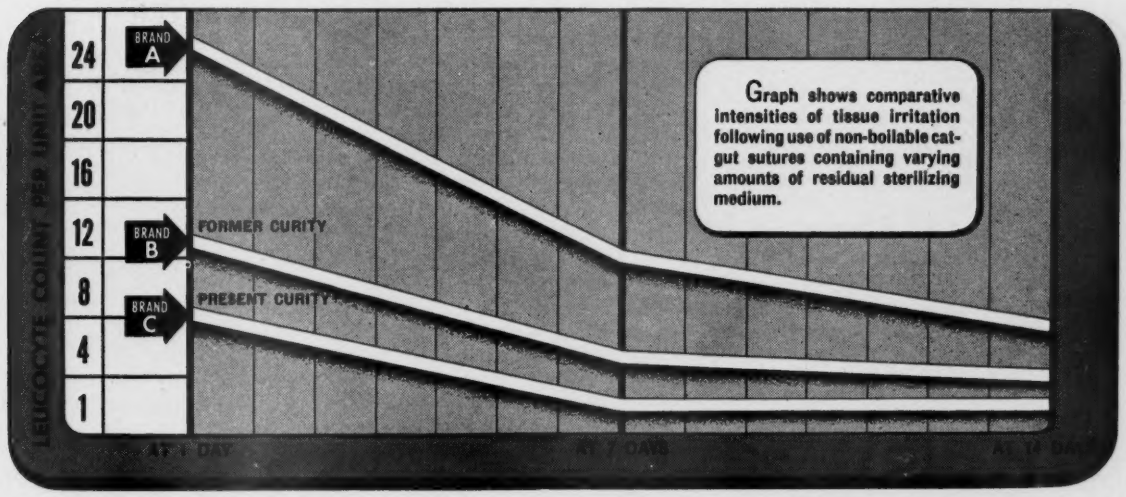

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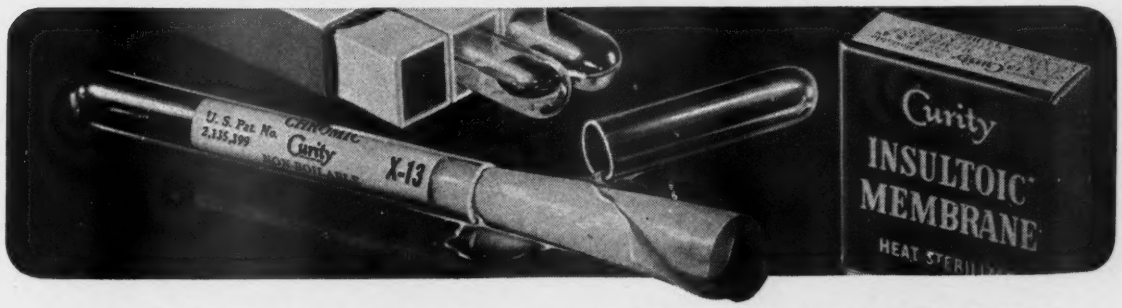

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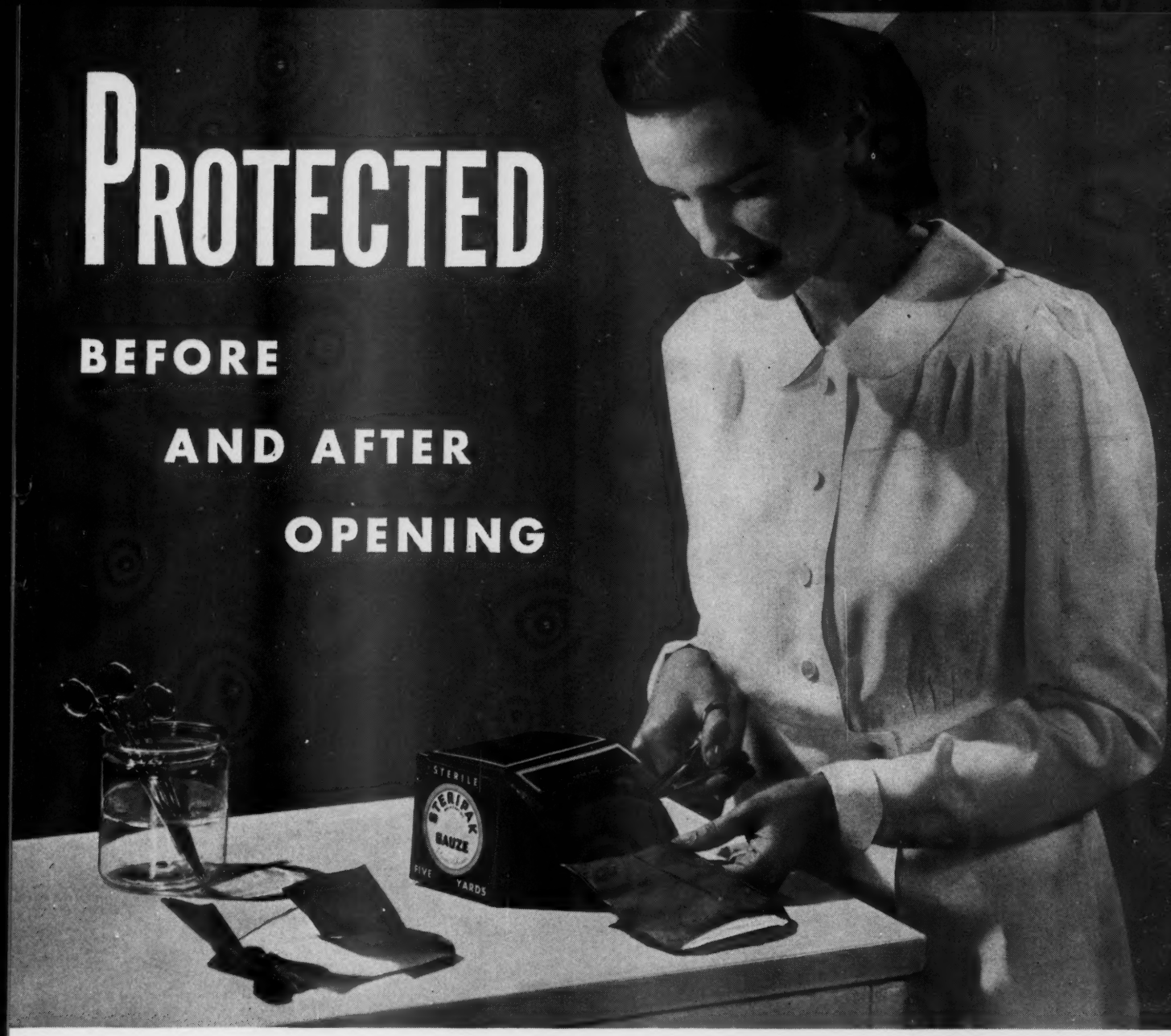

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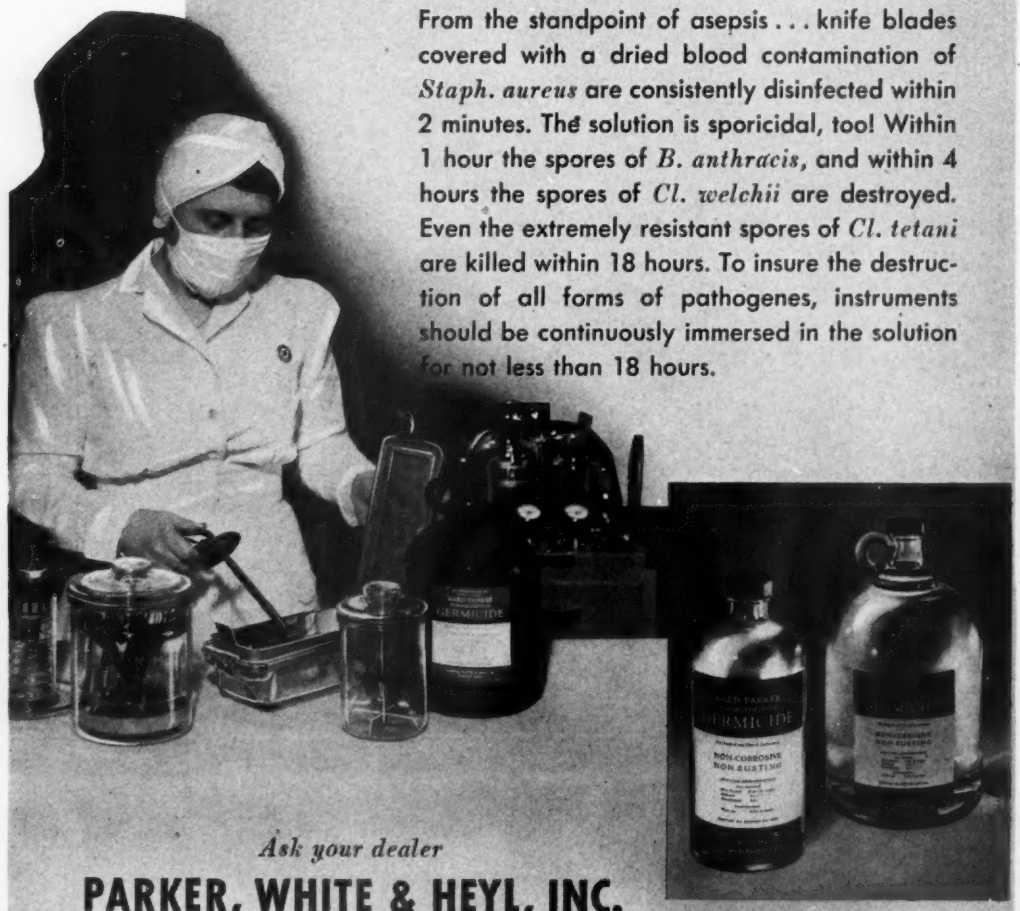

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One capsule daily of Squibb Special Vitamin Formula supplies the Recommended Dietary Allowances for a 70 Kg. man.

Each capsule contains:

5000 Units Vitamin A
800 Units Vitamin D
2 Mg. Thiamine Hydrochloride
3 Mg. Riboflavin
20 Mg. Niacinamide
75 Mg. Ascorbic Acid

Squibb Special Vitamin Formula Capsules are supplied to druggists in bulk. Generally dispensed on prescription for 5 or 6 cents per capsule, in any quantity designated.

Combat malnutrition this modern way. Use Squibb Special Vitamin Formula Capsules.

- ***For Therapy***
- ***Diet Supplement in Health***
- ***Diet Supplement in Convalescence***

[1] National Research Council, Reprint and Circular Series No. 115, Jan. 1943.

Literature available on request.

E·R·SQUIBB & SONS

Manufacturing Chemists to the Medical Profession Since 1858

★ BUY MORE WAR BONDS ★

Low Tissue-Toxicity

YET POWERFULLY GERMICIDAL

Phe-Mer-Nite Tincture and Phe-Mer-Nite Solution combine high bactericidal power with notably low tissue toxicity. In preoperative skin preparation, the Tincture (1:3000 alcohol-acetone-aqueous solution) produces dependable skin sterility within 3 minutes; soap and water readily remove the residual color. Since Phe-Mer-Nite Solution (1:1000) retains its germicidal potency in the presence of blood serum, it finds many uses in everyday practice, in the hospital, and in industrial plants.

PHE-MER-NITE

(Brand of Phenylmercuric Nitrate)

Virtually nontoxic. Does not precipitate tissue proteins. Diluted 1:4 (water) the Solution sterilizes instruments and rubber gloves harmlessly in 5 minutes. This Solution may be applied to burns and other lesions requiring antisepsis. Phe-Mer-Nite Tincture and Solution are supplied in gallon and pint bottles. Surgeons are invited to send for literature and liberal clinical test samples.

THE S. E. MASSENGILL COMPANY
Bristol, Tenn.-Va.

NEW YORK • SAN FRANCISCO • KANSAS CITY SEMCO

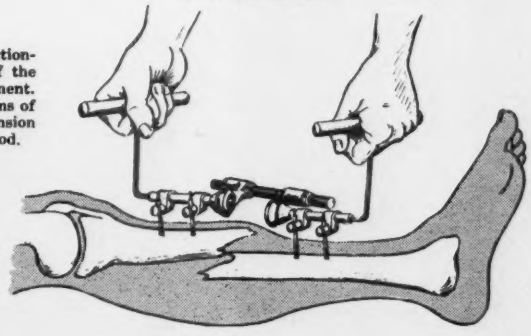
CHECK THESE ADVANTAGES

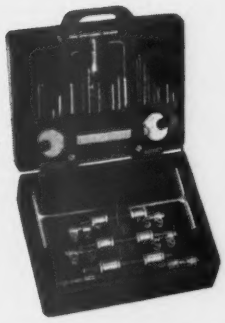
of AMBULATORY FRACTURE CONTROL

By ZIMMER

- It can make the patient ambulatory within 24 hours after operation.
- It functions as a reduction apparatus and also as an external fixation splint.
- It holds the fragments in position more securely than by means of plaster or other splinting.
- It permits free use of joints.
- It enhances circulation; hastens union.
- There is no interference with use of X-ray during reduction, or with check-ups at later periods.
- It is useful for impacting a fracture, or for bone lengthening.
- It is ideal for external fixation in cases of bone grafting.

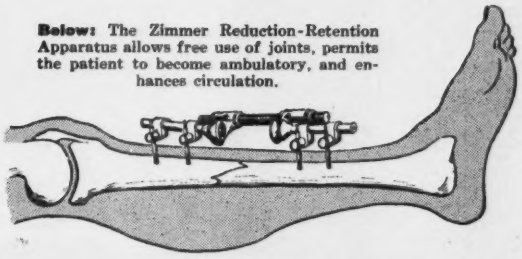
Right: Application of Zimmer Reduction-Retention Apparatus to a fracture of the tibia with shortening and displacement. The reduction is accomplished by means of removable handles or wrenches, extension being provided for by the threaded rod.





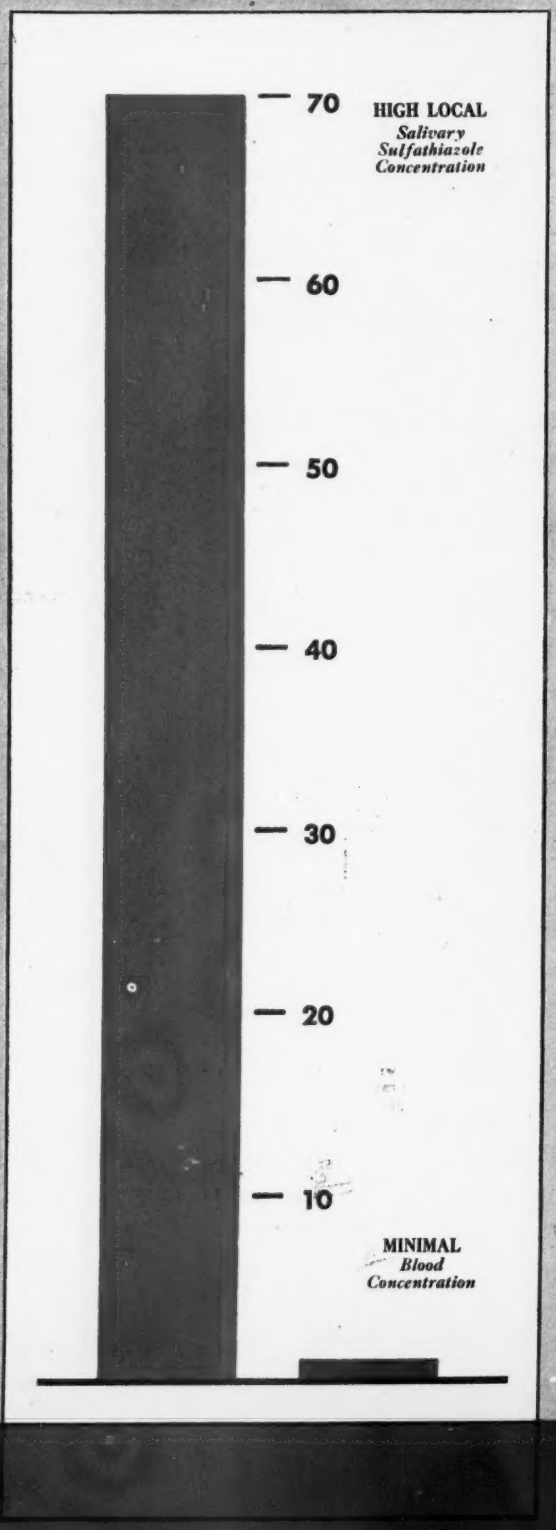
Above: Complete outfit of three sizes, including necessary tools and accessories, in fitted case.

Below: The Zimmer Reduction-Retention Apparatus allows free use of joints, permits the patient to become ambulatory, and enhances circulation.



● WRITE FOR FURTHER INFORMATION

Zimmer
MANUFACTURING CO., WARSAW, IND.



CHEMOTHERAPY

ON THE

SPOT

WITH

White's

Sulfathiazole

Gum

THIS new technique of local chemotherapy makes possible a high *topical* concentration of dissolved sulfathiazole throughout the entire oropharyngeal area—and for prolonged periods. Yet even with maximal dosage—and even in children—blood levels of the drug are so very low that there is minimal risk of the untoward reactions frequently associated with *systemic* treatment with sulfonamides.

One tablet, chewed for one-half to one hour, promptly initiates a high salivary concentration of locally active (dissolved) sulfathiazole—and *maintains* throughout the maximum chewing period an average concentration of 70 mgm. per cent.

Yet an average adult, chewing a total daily dosage of 8 tablets, for as long as an hour each, does not develop a blood level of sulfathiazole greater than 1 mgm. per cent.

The advantages of this new technique for treatment of sulfonamide-susceptible infections of oropharyngeal areas are obvious. White's Sulfathiazole Gum is supplied in packages of 24 sanitaped tablets, in slip-sleeve prescription boxes—on prescription only. White Laboratories, Inc., Pharmaceutical Manufacturers, Newark 7, New Jersey.

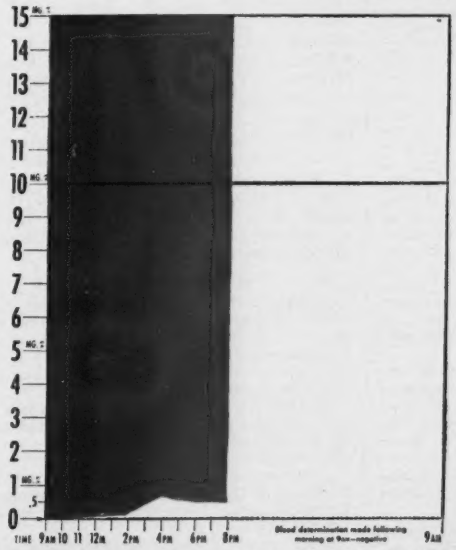
Generally maintained blood level in systemic therapy: 5 to 15 mg. percent average (10 mg. percent).

Chart contrasts sulfonamide blood level commonly maintained in *systemic* treatment, with that attained even with maximal dosage of Sulfathiazole Gum.

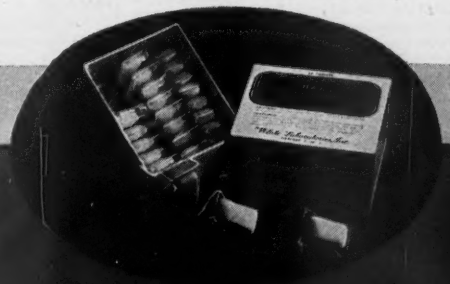
White area represents the sulfathiazole blood levels in an experimental adult group (average weight—153 pounds), each chewing 24 Sulfathiazole Gum Tablets over a 12-hour period. (Two tablets chewed every hour for one-half hour.) Sulfathiazole blood determinations were done at the intervals indicated on the base-line of chart. At no time was a level even as high as 1 mgm. % reached.

In an experimental group of children and adolescents, each of whom chewed 12 tablets of White's Sulfathiazole Gum, each tablet for one-half hour every hour, similar low blood levels were attained.

Since, in systemic therapy with sulfonamide compounds, blood levels of 5 to 15 mgm. % (averaged in green portion of chart as 10 mgm. %) are generally maintained, the use of White's Sulfathiazole Gum—even with maximal dosage—virtually obviates toxic reactions frequently associated with systemic treatment.



Average blood level attained with maximal dosage of Sulfathiazole Gum.



White's Sulfathiazole Gum

ut so far I have learned of no other
e suggestion which provides the neces-
fety valve which such an arrangement
would give. It would be tragic if a lot
ll business concerns were wrecked and
orkers thrown into idleness because of
nability to cut through the red tape
ed in getting their claims settled.

RESPONSIBILITIES OF CONTRACTORS

le making these statements with re-
o action by the Federal authorities, I
ize, also, that business concerns which
war contracts have a responsibility on
part to facilitate speedy settlement of
ated war contracts. They have the re-
bility for preparing their claims ac-
y and speedily and presenting them
per form. Some progress has been
oward getting a recognition of the
at industry must play in this respect,
rrently more and more experience of
ort is now being gained. The con-
g services of the Government, I know,
very helpful attitude toward this sit-
, and the local office of W. P. B. has
shed a regional advisory service for war
faced with problems resulting from
termination. That is a very helpful
nent.

ation to make possible the prompt
nt of terminated war contracts is
now. It will be unsafe to wait until
a deluge of contract terminations to
hrough legislation on short notice.
roblem is too complicated to be dealt
ffectively in that way.

MATERIALS FOR CIVILIAN PRODUCTION

ddition to making provision for the
ent of terminated war contracts, there
the task of facilitating the flow of
als for civilian production as soon as
materials can be spared from war pur-
I hope that we shall not have unem-
ent here in Massachusetts because
d materials, which are physically in ex-
e in the United States, are unavailable
by manufacturers as a result of leg-
or administrative restrictions. The
legislation vesting the priority power
President, which power of the Presi-
delegated to the Chairman of the War
on Board, is probably adequate to
the flow of materials, but it may be
ry for the Congress to make sure that
ministration of the priority power by
ar Production Board is directed effec-
oward the speedy and smooth resump-
f civilian production. The War Pro-
n Board should be expected to elim-
limitation orders, its conservation
and its allocation systems just as
n the needs of the war program per-

use of their effects on plans for re-
yment, I foresee that these problems
tling canceled contracts and securing
pplies of raw materials for civilian pro-
n will presently be matters of wide-
concern here in Massachusetts.

ummarize, my specific recommenda-
re that legislation should be enacted
r the following points:

EMENT OF TERMINATED WAR CONTRACTS

terminated contracts should be set-
egotiation by the contracting agen-
the Government, and the negotiated
nt should be final in the absence
or misrepresentation.

mpt partial payments amounting to
large percentage of the claim should
d to each contractor upon submittal
ified statement of the claim, subject
, to a penalty for perjury.

al settlement committees should be
red to authorize partial payments
delay of over 30 days occurs on the
the Government agency.

4. Contracting agencies should be required to give prompt clearance of claims on work in process. There should be clear-cut procedures for authorizing the removal of Government-owned inventories and machines, with storage at Government expense, in order that civilian production may be started.

5. The dilemma of the subcontractors must be resolved. At the present time the Government exercises the right of approving all payments in settlement of subcontracts but does not assume any responsibility to the subcontractor, with the result that the subcontractor in many cases cannot secure action by either the prime contractor or the contracting agency. I suggest that the local settlement committees proposed above should be empowered to approve settlement of subcontracts if a delay occurs in approval by the contracting agency.

B. DECONTROL OF MATERIALS

1. As soon as war conditions permit, the rules for the release of scarce raw materials should be revised, with a view to facilitating the rapid resumption of civilian production.

A Magnificent Job

EXTENSION OF REMARKS
OF
HON. LOUIS LUDLOW
OF INDIANA
IN THE HOUSE OF REPRESENTATIVES

Tuesday, January 11, 1944

Mr. LUDLOW. Mr. Speaker, Indianapolis and Indiana are very proud of the great pharmaceutical house of Eli Lilly & Co., which has processed its millionth blood donation without a cent of profit. This record is in keeping with the fine, generous spirit which this firm always has manifested in the service of our country and which long ago brought to it the recognition of an Army-Navy E award. Commenting on the company's contribution to the blood campaign, which means so much in saving the lives of our precious boys, the Indianapolis News says editorially:

LILLY'S CONTRIBUTION

In the midst of charges that some concerns are making an unholy profit from war contracts it is heartening to learn that the Indianapolis laboratories of Eli Lilly & Co. have processed 1,000,000 blood donations entirely on a nonprofit basis.

In addition to performing this service at cost, the expense involved has been decreased constantly through the introduction of more efficient methods.

There certainly could have been nothing unethical if the Indianapolis pharmaceutical house had sought a minimum profit for the work it has been doing.

Donations of blood at Atlanta, Chicago, St. Louis, Detroit, Cincinnati, Louisville, Columbus and Indianapolis have been converted into live-saving plasma at the Lilly plant, involving the installation of new equipment and the employment of much additional skilled personnel.

The patriotic Americans who donated this blood, however, got nothing for their contributions and the Lilly Co. determined that its connection wiht the effort to strengthen the wounded on every fighting front should be entirely shorn of private gain. From beginning to end, it has been and is—a magnificent job.

The Gates Must Not Be Closed

EXTENSION OF REMARKS
OF
HON. SAMUEL DICKSTEIN
OF NEW YORK
IN THE HOUSE OF REPRESENTAT

Tuesday, January 11, 1944

Mr. DICKSTEIN. Mr. Speaker, leave to extend my remarks in the ORD, I include the following editoria the Daily Mirror of January 4, 194

THE GATES MUST NOT BE CLOSE

When Congress reconvenes on Janu it should take up the Gillette-Taft-Bal Rogers resolution.

This resolution calls for the format a Presidential commission to create m ery, in conjunction with the Unite tions, to rescue the millions of Jew are now being systematically exterm by the Nazis and their Quislings.

When the Presidential commission g work, one of the first things it shoul to seek the abrogation of the Cham "White Paper" of May 1939.

At present, Palestine is being admi by Great Britain in conformity with t icy embodied in the "White Paper," tue of which Jewish immigration int tine is now limited and is to be pr stopped after March 31, 1944. The to be reduced to a permanent min 33⅓ percent in the country and the land to Jews is to be practically pro

A DIRECT REPUDIATION

This is a direct repudiation on En part of the League of Nations Mands the Balfour Declaration incorporated mandate of 1917.

According to this declaration, Palest to become a national Jewish home un protectorate of England.

In 1939, after the Jews had created ern civilization in what was practic Arabian desert, England turned h on her solemn promise of 1917.

This perfidity of Britain toward t was denounced by no one more vig than by Winston Churchill in Parlian the debate on the "White Paper" when he said:

MR. CHURCHILL'S REGRET

"As one intimately and responsib cerned in the earlier stages of our P policy, I could not stand by and see engagements into which Britain has before the world set aside for reason ministrative convenience or for the quiet life. I should feel personally rassed in the most acute manner myself by silence or inaction to wha regard as an act of repudiation.

"I regret very much that the pledg Balfour Declaration, endorsed as it h by successive governments, and the tions under which we obtained the m have both been violated by the Gover proposal.

"I select one point upon which plainly a breach and repudiation of four Declaration—the provision tha immigration can be stopped in 5 ye by the decision of a Arab majority. A plain breach of a solemn obligation

As the Palestine Mandate was ord the League of Nations, it cannot b gated even by Great Britain herself the consent of the League.

A SOLEMN OBLIGATION

But the League did not give its con the 1939 abrogation.

EASIER PATIENT BURDEN

WITH THE

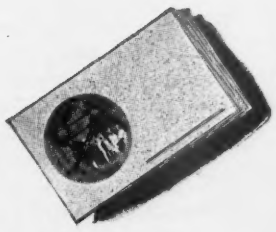
SINGER SURGICAL STITCHING INSTRUMENT

By efficient suturing, operative time is shortened. The Singer Surgical Stitching Instrument can thus aid in reducing the need for longer anaesthesia; and this is an important factor in lessening the incidence of serious post-operative complications not always directly related to the operative pathology.

Moreover, only part of the Singer needle passes through the tissue; and by the provision of a special groove in the under side of the needle, to carry the suture material within the cross-section circumference of the needle itself, local suture trauma is kept to a minimum. The Singer technique also facilitates the use of many new continuous stitches, by which tissues may be held in approximation with more equalized tension. Better wound healing is promoted, with less scar tissue formation.

Any standard suture material—or any of a variety of available needle sizes, shapes and styles—may be used with the Singer Surgical Stitching Instrument, which lends itself with equal facility to manipulation in both deep and superficial fields.

The instrument is precision made, with all parts rust-resistant. It may be sterilized as a complete unit, and can be readily taken apart for cleaning and reassembly.



Illustrated booklet furnished on request. Write Dept. A-3
Motion pictures demonstrating operative technique also available for group meetings.

SINGER SEWING MACHINE COMPANY, *Surgical Stitching Instrument Division,* **149 BROADWAY, NEW YORK 6, N. Y.**

Personal demonstration available at your local Singer Shop

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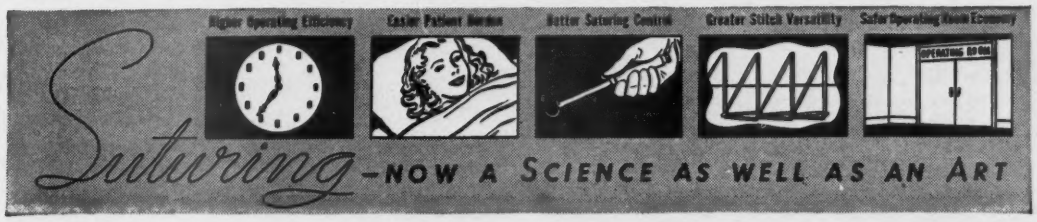
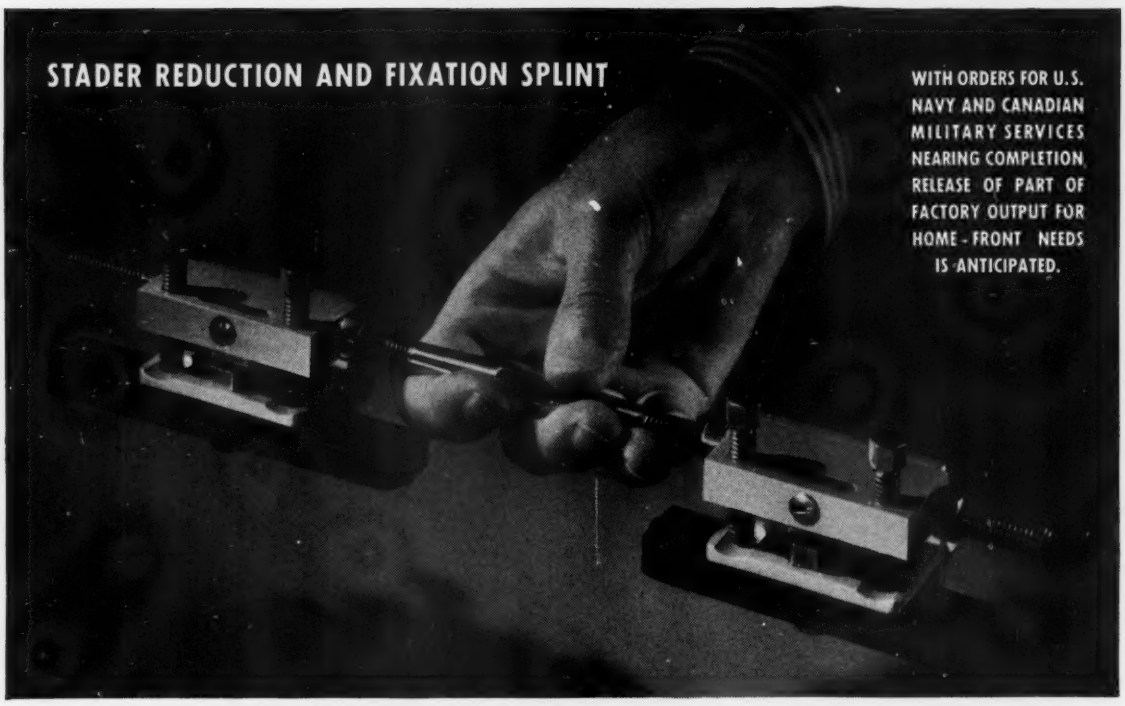

Higher Operating Efficiency
Easier Patient Burden
Better Suturing Control
Greater Stitch Versatility
Safer Operating Room Economy
Suturing—NOW A SCIENCE AS WELL AS AN ART

Soon Available FOR CIVILIAN USE


STADER REDUCTION AND FIXATION SPLINT
WITH ORDERS FOR U.S. NAVY AND CANADIAN MILITARY SERVICES NEARING COMPLETION, RELEASE OF PART OF FACTORY OUTPUT FOR HOME-FRONT NEEDS IS ANTICIPATED.

To surgeons everywhere, and especially to many who have been inquiring about the Stader Splint—where they might obtain it and when—we are pleased to submit this note of optimism, which at the moment seems justified.

During the many months when the factory's entire output of Stader Splints has been required to meet scheduled deliveries to the Military services, obviously it was impossible to provide for civilian needs. And the patience of those who have been kept waiting is duly appreciated. Now we have reason to believe that home-front requirements can soon be partially satisfied.

The selection of the General Electric X-Ray Corporation as sole distributor of the Stader Splint assures hospitals, clinics, and surgeons of a convenient source of supply, since G-E's direct branches and regional service depots are readily accessible everywhere.

Combining mechanical reduction and subsequent fixation in a single compact unit, the Stader Splint has proved, in extensive clinical use, a highly practical device for the treatment of many types of fractures by external skeletal fixation.*

Orders for the Stader Splint will receive attention in the order of their receipt, when stocks become available from time to time for civilian use. May we therefore suggest that your order be placed now. Specifications and Prices on Request.

*You'll find the recently published book, *Manual of Fractures—Treatment by Skeletal Fixation* a reliable source of information on various applications of the Stader Splint. The authors, C. M. Shaar and Frank P. Kreuz, Jr., both of the Medical Corps, U.S. Navy, describe methods used over a period of two years.

$3.00 per copy, postpaid. Subject to increase by sales (or use) tax, when applicable.

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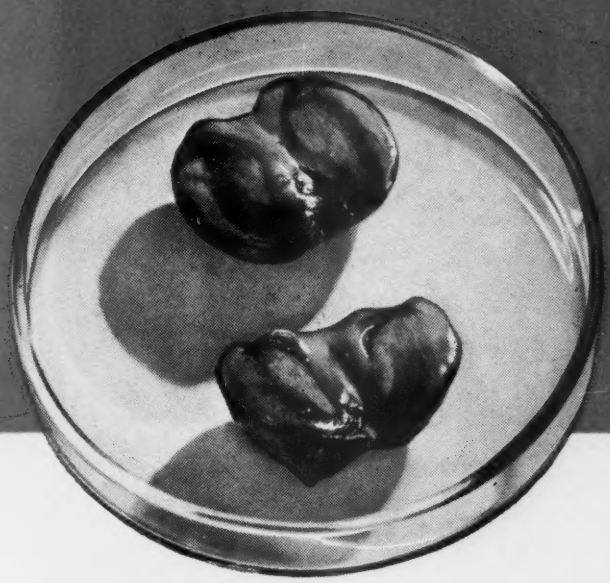
X-RAY CORPORATION
2012 JACKSON BLVD. CHICAGO (12), ILL. U.S.A.

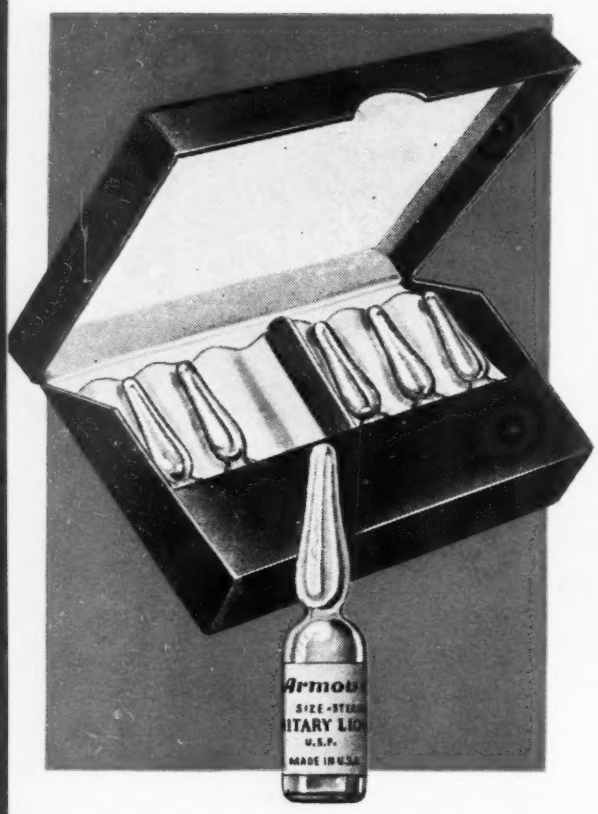
★ *Today's Best Buy – U.S. War Bonds* ★



The solution of the active principles derived from the posterior lobe of the pituitary body is of fundamental importance to the surgeon

THESE PAGES DESCRIBE A FEW OF THE APPLICATIONS OF PITUITARY LIQUID ARMOUR

together with some useful data on Suprarenalin Armour



PITUITARY LIQUID Armour

is prepared from carefully dissected posterior lobes of fresh, selected animal glands. It is processed carefully in specially designed laboratory equipment and standardized on the guinea pig uterus for its oxytocic potency.

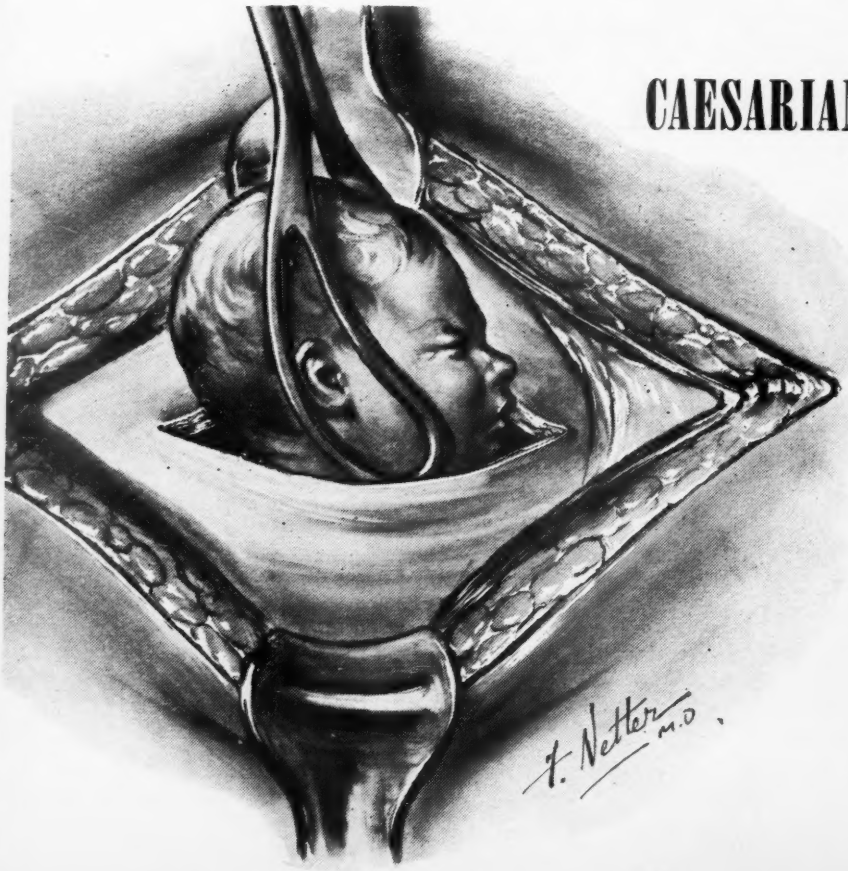
This sterile solution of the physiologically active constituents of the posterior lobe of the pituitary body meets all requirements of the U. S. Pharmacopeia XII.

Posterior Pituitary Liquid *[Armour]* is available in two strengths:

Pituitary Liquid U. S. P. XII.—Obstetrical *[Armour]*—standardized for its oxytocic action—each cc. contains 10 U. S. P. Units.

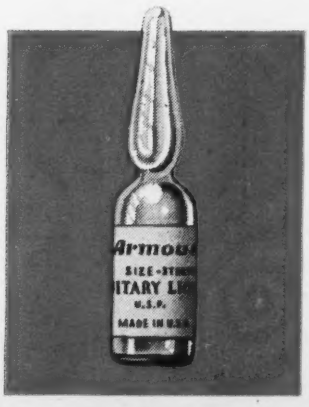
Pituitary Liquid U. S. P. XII—Double Strength—Surgical—*[Armour]*—each cc. contains 20 U. S. P. Units.

Some of its many applications are described briefly and illustrated here.



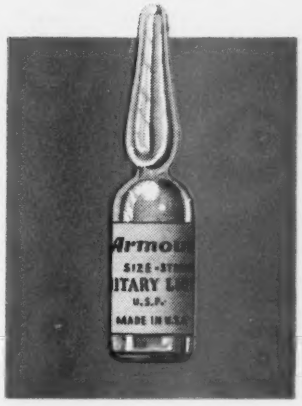
CAESARIAN SECTION

Pituitary Liquid Armour, used judiciously, is a valuable aid in certain phases of caesarian section. Many obstetricians administer it subcutaneously or intramuscularly to arrest hemorrhage immediately following delivery of both baby and placenta.

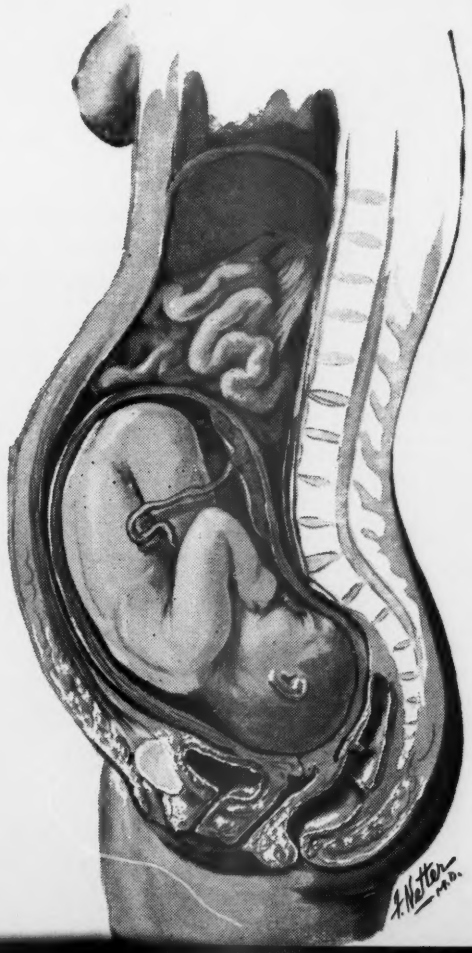


INTESTINAL ILEUS

Intestinal distention post-operatively may cause the patient much distress and may at times progress to a true paralytic ileus. The action of Pituitary Liquid Armour in increasing the tonicity and activity of the intestinal musculature has been utilized for many years to good advantage in overcoming distention and preventing ileus. Expulsion



of flatus and relief from abdominal distress often follows soon after the injection of 1 cc. The dose may be repeated in four hours. Bladder tone is restored also, thus facilitating elimination.



IN OBSTETRICS

Pituitary Liquid therapy is a powerful and efficient means of stimulating uterine contractions. For the safety of the mother and child, therefore, Pituitary Liquid *[Armour]* should not be employed in cases in which delivery is delayed by deficient action unless, and until, it has been established definitely that the cervix is dilated fully, and there is no disproportion of the parts or fetal malposition. Employed properly and judiciously, however, it is a valuable addition to the obstetrician's armamentarium.

Serum Disease!

• Following a therapeutic injection of a foreign serum the patient may develop a rash, joint pains, fever, edema of the face and other symptoms—the clinical picture of "Serum Disease." The patient may be truly miserable. For relief, SUPRARENALIN (epinephrine) *ARMOUR* is most valuable. Repeated injections, in properly graded doses, often control the symptoms.

In asthmatic paroxysm, asphyxia, angioneurotic edema, and many other conditions, SUPRARENALIN is likewise a valuable therapeutic agent. In local and topical anesthesia the addition of SUPRARENALIN SOLUTION to the anesthetic prolongs the effect and lessens likelihood of toxic absorption.

The dependability of SUPRARENALIN *ARMOUR* is a result of forty-five years of experience in the manufacture of endocrine preparations. Armour technicians know how to judge and select animal glands; Armour chemists are skilled in preparing endocrine medicinals and, most significant of all, they have available the world's largest supply of fresh raw material from which to choose.

Have confidence in the preparation you administer—specify ARMOUR.

℞ *Suprarenalin Armour*

Available in these forms:

SUPRARENALIN SOLUTION 1:1000
Supplied in 1 cc. ampoules and 1 oz. rubber-capped vials.

SUPRARENALIN CRYSTALS
Supplied in 1 grain vials.

SUPRARENALIN INHALANT 1:100
Supplied in ¼ oz. and 1 oz. bottles for oral inhalation.

SUPRARENALIN SOLUTION 1:10,000
1 cc. ampoules for hypodermic or intravenous use.

SUPRARENALIN-GELATIN MIXTURE (Epinephrine 1:500)
Supplied in 10 cc. rubber capped vials for intramuscular use.

Literature sent upon request.

THE ARMOUR LABORATORIES,
CHICAGO, ILLINOIS

ARMY E NAVY

For Excellence in War Production

Quoted

from one of more than 400 published papers

"In this series, it was found that intravenous pentothal sodium anesthesia, supplemented by continuous inhalation of 100 per cent oxygen, produced muscular relaxation equal to that of spinal anesthesia. This observation is so important it should be stressed, as many authors do not agree. The concomitant use of oxygen and intravenous pentothal sodium thus permits the maintenance of a depth of anesthesia allowing complete muscular relaxation, and makes intravenous pentothal sodium more widely applicable in various surgical procedures."

Edison A. French, M. D.
San Luis Obispo, Calif.

Pentothal Sodium-Oxygen Anesthesia in Major Surgery

Am. J. Surg., 61:16, July, 1943

FOR INTRAVENOUS ANESTHESIA

Pentothal Sodium

REG. U. S. PAT. OFF.

[SODIUM ETHYL-(1-METHYL-BUTYL)-THIOBARBITURATE, ABBOTT]

Descriptive literature will be sent upon request. Address inquiries to
ABBOTT LABORATORIES
North Chicago, Illinois

Versatile Anticoagulant

HEPARIN

Lederle

PACKAGED IN ONE 10 CC. VIAL

HEPARIN NEED IS frequently an emergency. *Lederle* maintains stocks at strategic points throughout the United States. A telegram or telephone call to the nearest Lederle Depot will bring "HEPARIN, *Lederle*" by the quickest possible means.

THE SURGEON finds heparin invaluable in—

- **Postoperative embolism or thrombosis**
- **Vascular occlusion following arterial surgery**
- **Mesenteric thrombosis**

THE INTERNIST finds heparin exceptionally useful in—

- **Femoral thrombophlebitis**
- **Pulmonary embolism**
- **Retinal thrombosis**
- **Clot formation during whole blood transfusions**

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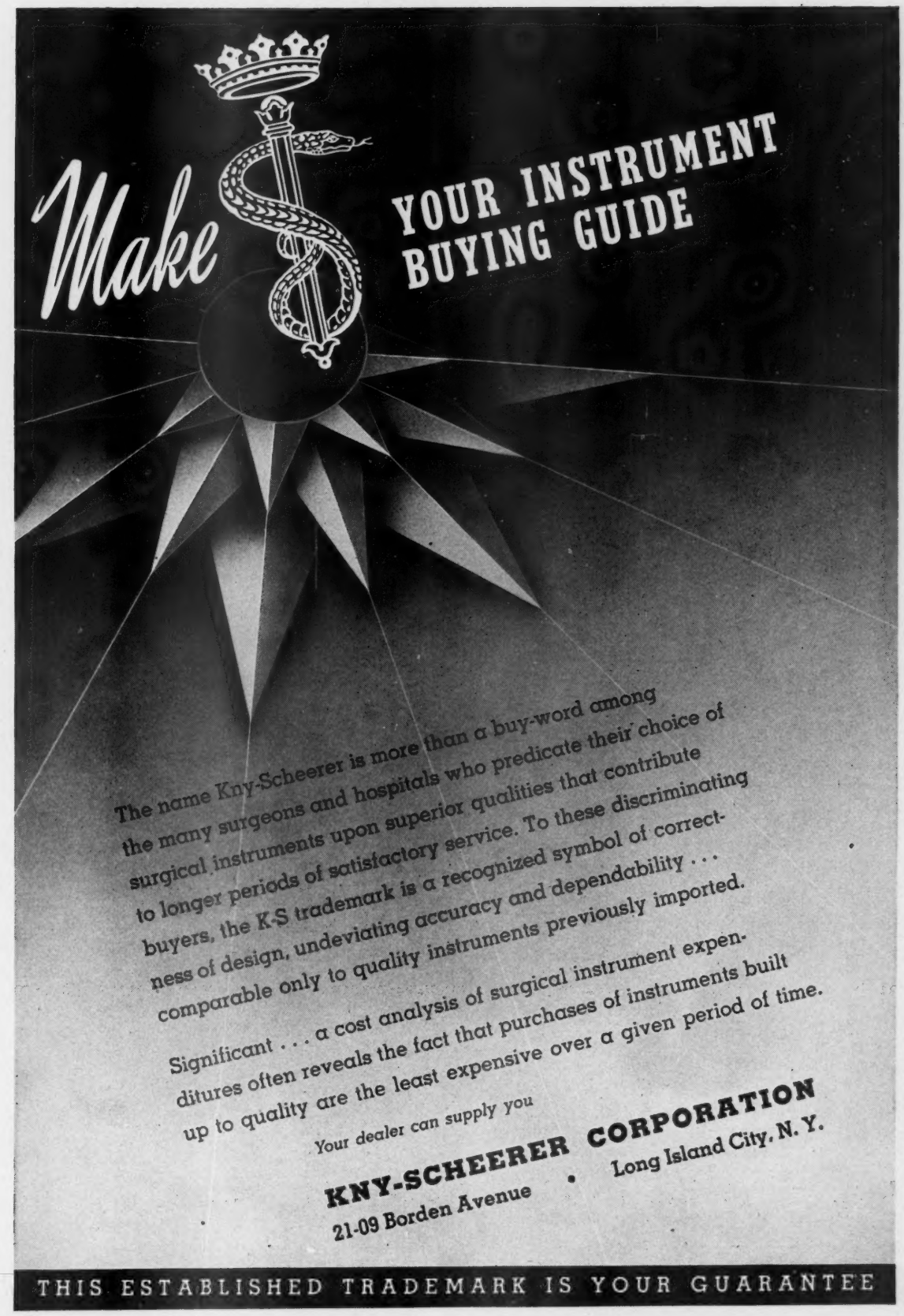
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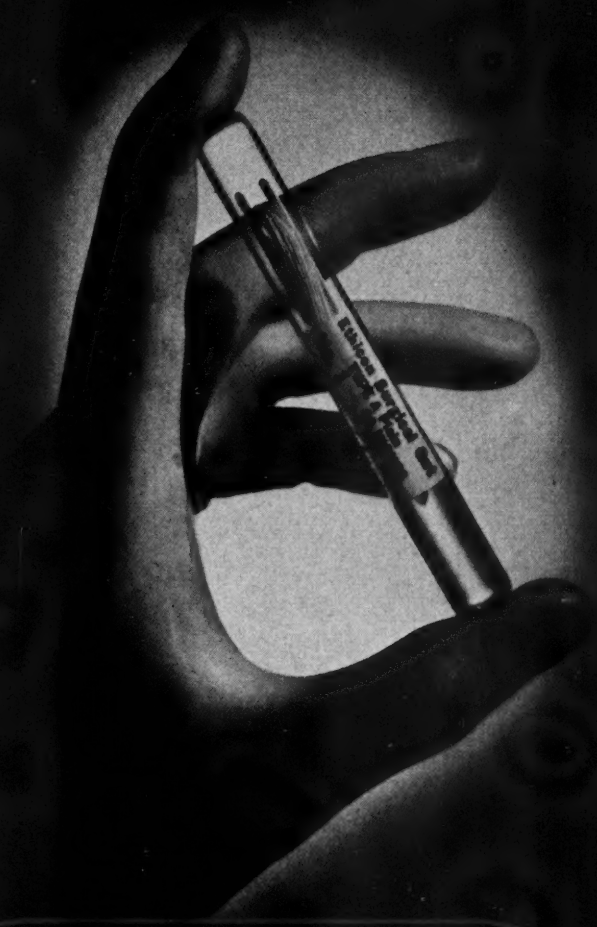

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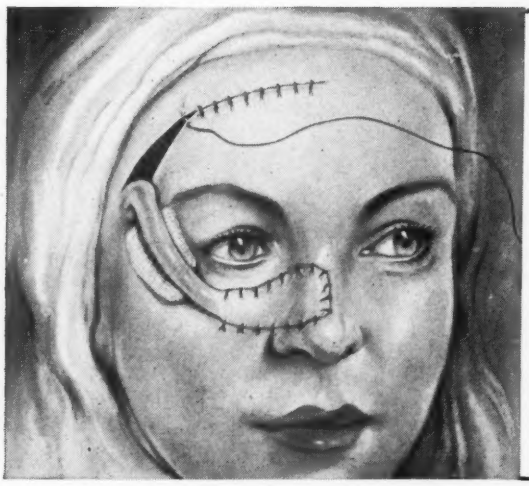

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Editorial

SURGICAL RENAL TUBERCULOSIS

INASMUCH as the latest statistics show that tuberculosis in general is on the increase since war created profound changes in living standards throughout the world, it is reasonable to expect that this increase will be observed in renal as well as in other forms of this disease. It is accordingly worth while to emphasize the importance of the early diagnosis of this condition, and the possibility of its complete eradication by surgical treatment, when it has reached the open stage.

Albarran, in the beginning of this century, was the first to introduce this principle of modern urology, pointing out that removal of the one kidney affected would result in complete cure. Although he had no urographic means of diagnosis, he was able, in the face of opposition and destructive criticism, to demonstrate by results that this principle was sound. His work in this field is essentially the basis of what we know today of the solution of this fascinating problem.

Renal tuberculosis, which is a blood-borne infection from some other primary focus, is unilateral in 80 to 90 per cent of cases, the original lesion being in the lungs, lymphatics or bony system, in which it may have become quiescent but has later produced manifestations in the kidneys or genitourinary tract. Once in this tract, it falls into two main groups, the one medical, or closed, the other, surgical, or open. The medical group comprises the cases of miliary tuberculosis and tuberculous nephritis, both characterized by presence of tuberculous bacilluria. So long as the lesions remain closed, that is, isolated within the renal parenchyma and expressed only in a bacilluria, without other symptoms in the urinary tract, they may heal. Such cases do not require surgical treatment. Once they have opened into the excretory apparatus, however, no treatment will be effective except nephrectomy. It is these open cases which constitute the recognized entity of tuberculosis of the kidney. It is called surgical renal tuberculosis because its only cure is by surgical means. By the time a case becomes open, the pathologic process is well established and has destroyed the parenchyma of the kidney, forming typical caverns such as are seen in pyonephrosis. The kidney as a rule drains its caseous contents into the calices, renal pelvis and ureter, producing pyuria, hematuria, and other marked urinary disturbances, characterized by bladder symptoms for which the patient is referred for urological consideration.

The diagnosis is readily made in these urographic days, and is based on (1) cystoscopic data, (2) catheterization of

both ureters in the differential renal test, (3) roentgenographic and pyelo-urographic evidence of a well established lesion, and (4) laboratory data based on positive smear for Koch's bacillus in the urine, or positive culture, or positive guinea pig inoculation. With these fundamental data one is in a position to establish a correct diagnosis for renal tuberculosis. Upon these data and the verification of a normal pyelogram of the kidney of the opposite side, one may always feel assured that the indication is present for nephrectomy of the diseased kidney.

In the surgical management of renal tuberculosis it is also important today to consider not only the pathologic condition of the kidney, but also the surgical lesions that may involve the ureter and urinary bladder, which will demand further treatment. There are two types of surgical renal tuberculosis with lesions of the ureters which can be established urographically previous to operation. The first is the type of hydro-ureter, or megalo-ureter, or the ureter in which there is a vesico-uretero-renal reflux. The second is the group of cases in which the ureter is infiltrated, with marked ureteritis, and indurated to such an extent that it can be detected by rectal or vaginal palpation. In these two types, demonstrable before operation, a combined ureteronephrectomy by two separate incisions is the procedure of choice. In those instances, however, in which an advanced lesion of the ureter has not been properly recognized in advance, and is discovered only in the course of a nephrectomy, the lumbar incision should be prolonged to include a ureterectomy. This total and radical procedure is simple, and assures a permanent cure. It is important, from a surgical point of view, to emphasize that if the ureter is not removed *in toto* when it is tuberculous, it may produce a uropurulent lumbar fistula, or a persistent cystitis, which will demand a subsequent secondary ureterectomy. Electrocoagulation or fulguration of a tuberculous ulcer of the bladder will be useless if the stump of a tuberculous ureter has not been removed at the time of the nephrectomy. In the past, many failures following nephrectomy have been attributable to this oversight on the part of the surgeon who has not removed this tuberculous focus, which inevitably infects the bladder and may also cause ascending infection of the other kidney.

In the surgical problem of bilateral renal tuberculosis, present in 10 to 20 per cent of cases, we are again confronted with two principal types: In one of these the pyelographic data and differential renal functional tests reveal destruction of the papilla, calices and renal parenchyma, while the urographic studies of the kidney of the opposite side show that this organ is still normal, even though the catheterized specimen discloses an excretory tuberculous bacilluria. Here nephrectomy is obviously indicated. In the other group, the destructive pathologic process is far advanced and can be demonstrated in the retrograde pyelogram of both kidneys. In such cases no surgery seems to be indicated, except in those in which a large pyonephrotic kidney is present, which calls for drainage by a simple lumbar nephrostomy, to relieve symptoms and prolong life. This principle also applies in the exceptional case of an acquired single kidney in which the tuberculous disease is far advanced.

It is well to emphasize that the sulfa drugs, which have come to be regarded as a panacea for all infections, have no effect upon the tubercle bacillus. For this reason a persistent pyuria and dysuria, with marked nocturia and bladder tenesmus, should be promptly investigated from the urological angle without wasting time in the use of these new chemotherapeutic measures or other forms of palliative treatment.

It should be borne in mind, however, that nephrectomy is only the first step in the general management of tuberculosis of the kidney. After operation the patient

must be submitted for a considerable period of time to a proper dietetic regimen, suitable hygiene, medical care and rest, preferably in the quiet of a sanatorium, in order to build up bodily resistance against the toxins of the Koch bacillus, which may still be present in the lungs or blood stream. There will be no permanent cure of renal tuberculosis until the primary focus within the kidney has been removed. The few isolated cases that have been reported of so-called healed tuberculosis of the kidney are not convincing, since in most of these the malady has recurred with all its annoying bladder symptoms; and in some there has been anatomopathologic proof at autopsy of the persistence of the tuberculous lesion in the kidney. Even in cases of so-called autonephrectomy or complete calcification or caseation of the whole organ, in which the patient has gained in weight and strength temporarily, the specimen removed at operation has revealed actual caverns and obviously active tuberculous lesions.

The convenience and facility of spinal anesthesia, the improvement in surgical technic and in the pre- and postoperative care of these tuberculous patients have all contributed to the lowering of the morbidity and mortality, and have assured better curative results.

The curability after nephrectomy is high, the operative mortality very low, depending of course upon the condition of the patient, the stage of the disease and whether the primary lesion in the kidney is unilateral or bilateral. The prognosis is on the whole excellent with this train of treatment for obtaining a permanent cure.

In addition it can be said that the surgical treatment of renal tuberculosis offers to the community and to the world at large a better control of the propagation of this age-long scourge of humanity, removing a source of contamination for which medical science has as yet found no specific cure.

The enormous experience and abundant clinical data which have been accumulated in this accurate cystoscopic and urographic era prove the sound wisdom of establishing in renal tuberculosis an early diagnosis, followed by an early nephrectomy. For the discovery and application of this principle, which is one of the greatest achievements of modern urology, we are forever indebted to its originator, the great Albarran.

Robert Gutierrez, M.D.

Original Articles

CANCER OF THE LIP*

A STUDY OF FIFTY-SIX FIVE-YEAR CASES

C. A. WHITCOMB, M.D.
PHILADELPHIA, PENNSYLVANIA

THE term cancer of the lip is used here to mean a malignant neoplasm of the exposed margin of the lip, the part of the lip which is seen when the lips are closed, and of the regional lymph nodes of the neck. Cancer of the skin of the lip (Fig. 1A), of the mucous membrane of the lip (Fig. 1B), and of the labial commissure (Fig. 1C) are not included in the term because the course of these neoplasms is different. Cancer of the lip is more malignant than cancer of the adjacent skin and less malignant than cancer arising from the mucous membrane of the lip and from the labial commissure.

Cancer of the lip occupies a unique position among malignant tumors. No tissue of the body affords the oncologist better opportunity to observe all phases of the behavior of malignancy. Cancer of the lip was the type of malignancy first used by Broders to correlate the degree of anaplasia of cancer (the histological grade), and the result of surgical treatment. It is sufficiently malignant to present all of the therapeutic problems of cancer, yet not so malignant as to prevent sound treatment producing encouraging results. Cancer of the lip is also a type of malignancy which is particularly favorable for the reduction of cancer mortality and is suitable for demonstration to laymen of the curability of cancer.

Cancer of the lip is a dangerous disease. This statement would be a platitude if it were well known to all men of sixty and remembered by all physicians. Many patients are not concerned by the insignificant, painless spot on the lip, and some doctors cannot yet resist the temptation to burn or cut, in their offices, a small primary cancer of the lip. Such physicians do greater harm by failure to follow up the disease and to warn the patient of the possibility of metastasis of the lymph nodes of the neck.

Cancer of the lip, after cancer of the skin, is the commonest type of malignancy occurring in men; 148 men were treated for squamous carcinoma of the skin of the face during the period in which fifty-six men were treated for cancer of the lip. Cancer of the lip is very infrequent in women and on the upper lip. Of the fifty-six cases which were studied, all were men; fifty-five cancers arose from the lower lip, one from the upper lip. (Fig. 2A.) The constancy of these findings excites one's curiosity regarding the etiological part played by sex and site. Most patients are old. The average age of the fifty-six patients was sixty-five years; the extremes of age in the group were thirty-five and eighty-five years.

Some patients state that the cancer began as a fever-blister, sun-poisoning or a trivial injury. The cause of cancer of the lip is not known, but leucoplakia and syphilis, when present, play a part in its course. All authors agree that cancer of the lip may arise in a patch of leucoplakia, a condition of undetermined con-

* From the Jeanes Hospital, Philadelphia, Pennsylvania.

stitutional background. The relationship between syphilis and cancer is not clear, but experience convinces one of the seriousness of the co-existence of the two diseases. Eight of the fifty-six patients had tertiary syphilis; three of the eight had signs of involvement of the cerebrospinal nervous system.

Cancer of the lip is a squamous carcinoma which, according to Broders' method of classification, is usually grade I or II. The grades of the fifty-six cases of squamous carcinoma studied were: grade I—thirty-two cases; grade II—seventeen cases; grade III—five cases; grade IV—no case; two cancers were not graded. (Table II.) This distribution of grades is similar to that of larger series of cases reported by Taylor,[1] by Martin,[2] and by Schreiner.[3]

Most of the interest in the histology of lip cancer centers about the usefulness of the grade of the cancer as a guide to the choice of surgical or radiation treatment. Broders[4] concluded that routine suprahyoid neck dissection was unnecessary in grade I cancer of the lip because cancer of that grade did not metastasize. However, thirty-two of the fifty-six lip cancers studied were classified as grade I; metastasis occurred in eight of these thirty-two cases (Table II), an incidence of 25 per cent, which is the approximate percentage of metastasis in large series of cases of all grades.

The different incidence of metastasis from grade I lip cancer in this group of fifty-six cases and in that studied by Broders is, apparently, explained in part by the difference of opinion among pathologists regarding the grade of a particular squamous carcinoma.

Cancer of the lip is not a painful disease; few cancers become tender. Lip cancer, as a rule, grows slowly. The average duration was eleven months in fifty-six patients, but the rate of growth varies in different patients and in the same patient at different stages of the disease. The duration of cancer is a guide to the intelligence and social status of the patient. The younger, intelligent patient seeks cancer treatment in two or three months, but the senile patient may wait two years.

A very early cancer of the lip appears as a clean, red, finely granular, oval erosion (Fig. 2B) outlined by an elevated margin of normal mucosa visible only by oblique light. Stiffness characterizes the erosion as cancer. The elevated margin is formed by the submucosal growth of cancer. As the cancer enlarges, the oval shape and the elevated margin are retained. Though the skin, the muscle and the mucous membrane of the lip are involved to some extent by continuity, cancer of the lip tends to respect these tissues. In some cases the

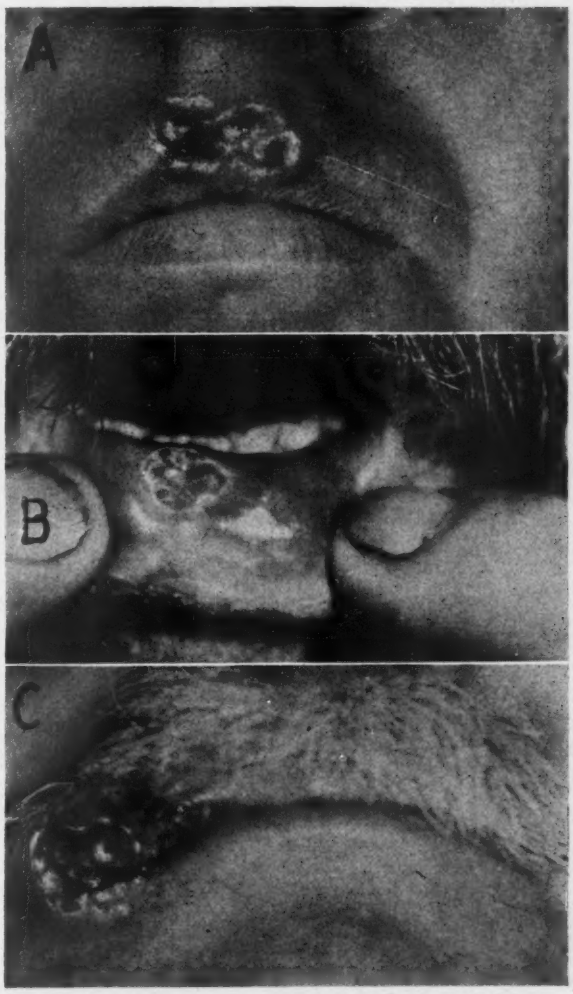


Fig. 1. Neoplasms of tissues adjacent to lip; not included in the term "cancer of the lip." Retouched photographs. A, basal cell carcinoma of skin of upper lip (woman); B, squamous carcinoma grade II of the mucosa of the lower lip; C, squamous carcinoma grade I of labial commisure; involving the mucosa of the cheek.

TABLE I

RELATION OF SIZE OF LIP CANCER TO INCIDENCE OF METASTASIS AND TO 5-YEAR SURVIVAL

	Size of Lip Cancer					
	2 cm. or Less	2–4 cm.	Over 4 cm.	Multiple Cancers	Size Unknown Destroyed before Admission	Total
Number of Patients	31	9	6	4	6	56
Metastasis						
Present at some time	4	5	2	3	6	20
Percentage present at some time	13	55	33	75	100	36
5-Year Survival						
Number of patients	26	3	2	1	0	32
Percentage of patients	84	33	33	25	0	57

TABLE II

RELATION OF GRADE OF LIP CANCER TO INCIDENCE OF METASTASIS AND 5-YEAR SURVIVAL

	Grade of Squamous Carcinoma					
	I	II	III	IV	Not Graded	Total
Number of patients	32	17	5	0	2	56
Metastasis						
None at any time	24	8	2	..	2	36
Present at some time	8	9	3	..	0	20
Per cent present at some time	25	55	60	..	0	35
On admission	3	2	1	..	0	6
On admission—lip cancer destroyed	1	3	2	..	0	6
After admission	4	4	0	..	0	8
5-Year Survival						
Number of patients	23	6	1	..	1	31
Percentage of patients	71	35	20	..	50	55

TABLE III

RELATION OF CERVICAL METASTASIS TO 5-YEAR CURE

Metastasis	No. of Patients	Lived 5 Years		Died before 5 Years				
				Total No. Dead	Cancer		No Cancer	
		No.	Per Cent		No.	Per Cent	No.	Per Cent
None at any time	36	30	83	6	0	0	6	100
Present at some time	20	3	15	17	17	100	0	0
On admission	6	1	16	5	4	80	1	20
On admission—lip cancer destroyed	6	0	0	6	6	100	0	0
After admission	8	2	25	6	4	66	2	33
Stage II	13	3	23	10	10	100	0	0
Stage III	7	0	0	7	7	100	0	0

cancer cells of the erosion multiply to form a smooth or cauliflower nodule (Figs. 2C and 3E) which may or may not ulcerate (Fig. 3C, D) or the cells die, thereby forming an ulcer with loss of the contour of the lip. (Fig. 3B.)

FIG. 2. Clinical types of squamous carcinoma of the lip. A, grade I; upper lip; died six and one-half years later from adenocarcinoma of the rectum; B, grade I, indurated erosion; common type; associated with incurable cervical metastasis shown in Figure 5; C, grade II; large warty nodule associated with leukoplakia of the lip; D, grade I; soft superficial irregular ulceration; E, grade I; infiltrating type, early stage; F, grade III; infiltrating type, later stage, involving tissues of the chin. The margin of the cancer is indicated by the ink mark on the skin.

Another clinical form of cancer of the lip occurs in older men who have had leukoplakia of the lip off and on for years. (Figs. 2C and 3F.) One or several small or large gray, scaly, or warty cancers may co-exist with patches of leukoplakia, the combination often extending the length of the lip. Leukoplakia may be the source, over the years, of a series of small, independent cancers which are not to be confused with recurrent cancer.

A less common and more dangerous kind of cancer, the infiltrating type (Fig. 2E) produces a hard, thickening of the deep tissues of the lip which has a relatively normal surface. In a more advanced stage (Fig. 2F) the hard area of the lip extends downward to form a diffuse, hard swelling of the soft tissues of the chin which is covered by normal skin. The periosteum of the symphysis of the mandible may be involved by inflammation or cancer.

Metastasis to regional lymph nodes appears in approximately 25 per cent of a series of cases of cancer of the lip. This figure is obtained by compiling the figures of large series reported by Taylor,[1] Martin,[2] Schreiner,[3] and other authors. Of the fifty-six cases studied, twenty had metastasis; twelve on admission (six of which were referred for treatment of cervical

metastasis only) and eight developed metastasis after control of the primary cancer. (Table III.)

The first and frequently the only metastasis involves the lumph node overlying the submaxillary salivary gland on the same side as the cancer of the lip; this occurred in seven of the twenty patients in this series.

An additional metastatic node was found in the following regions: the opposite submaxillary triangle (bilateral metastasis)—five cases; submental triangle—three cases; and carotid triangle—five cases.

The interval of time between the appearance of lip cancer and the discovery of metastatic lymph nodes in the twenty cases of metastasis studied varied from one month to two and one-half years; the average interval was twenty months. The interval averaged eleven months in the nine patients who developed metastasis after treatment of the lip cancer; the shortest interval was three months and the longest twenty-six months. The long interval of two and one-half years proves the need of a prolonged period of follow-up examination.

Metastatic cancer cells may remain confined for months to a single submaxillary lymph node which may reach a diameter of several centimeters without invasion of the overlying skin (Fig. 4A). Many of the largest metastases ever found in the neck are produced by cancer of the lip. Such a large metastatic node distends

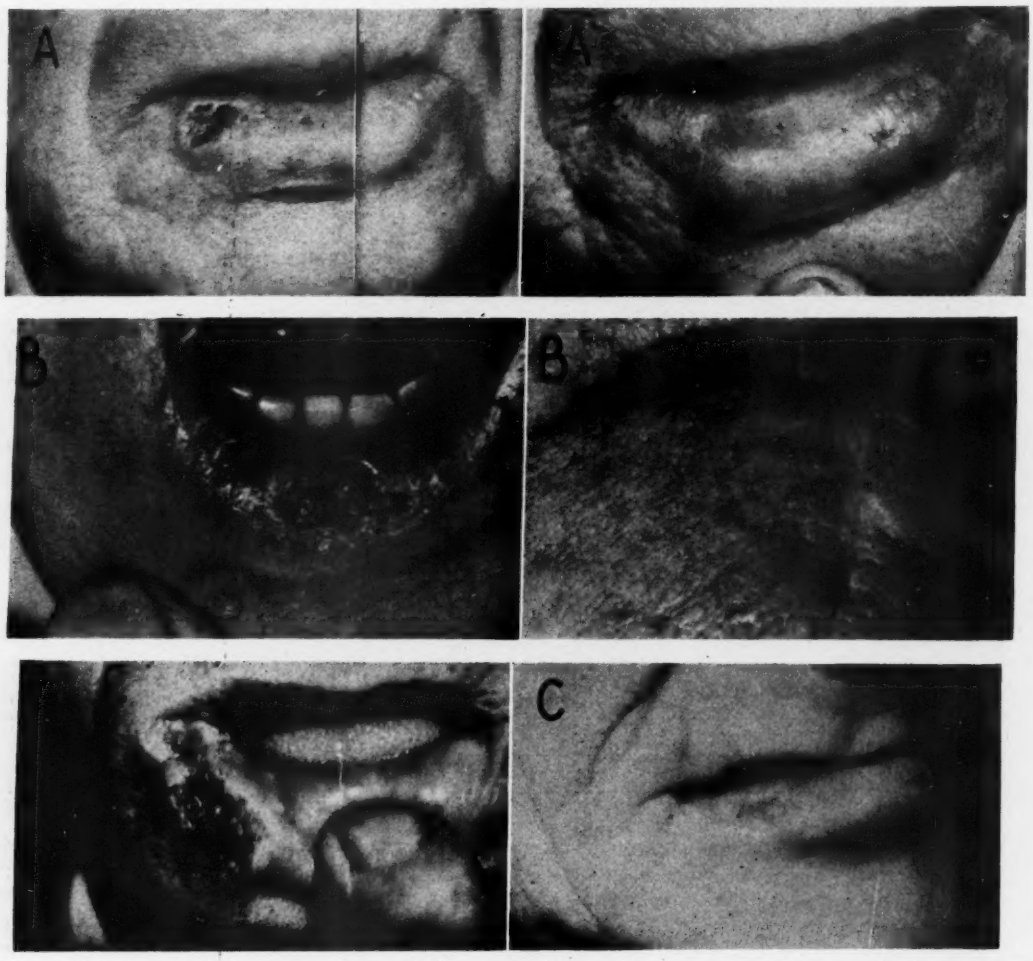
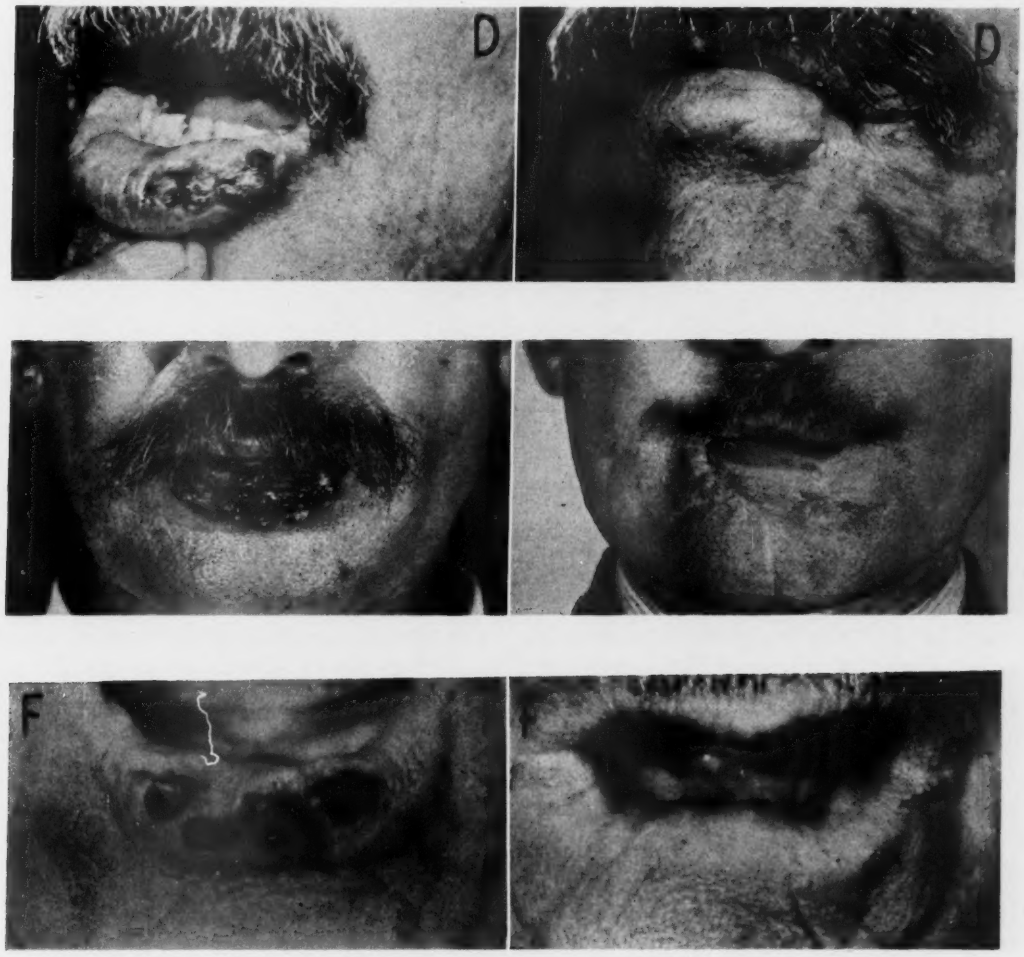


FIG. 3. Squamous carcinoma of the lip; before and after treatment. A, grade I; treated with radon applicator; B, grade II; treated by V-excision; C, grade I; treated with radon applicator; D, grade I; treated by V-excision; poor healing; luetic; E, grade II; treated by excision and plastic; Est-

the walls of the submaxillary space, overrides the margin of the mandible and elevates the floor of the mouth from which it is separated by the salivary gland. The metastasis may adhere, but not invade the periosteum of the margin of the mandible. Erosion of the margin of the jaw is occasionally seen in the *x*-ray film and very rarely the infiltrating type of lip cancer extends through the dental canal to the infratemporal fossa.

The incidence of visceral metastasis from squamous carcinoma of the lip is so low that the probability of visceral metastasis may be dismissed when one is judging a case. Metastasis of the viscera almost never occurs except in hopelessly advanced cases of cancer of the lip. Thoracic or abdominal metastases were found in only three of seventeen post-mortem examinations made following death from cancer of the lip.



lander triangle flap from right half of upper lip; F, grade II; multiple cancers treated by excision of the entire exposed portion of lower lip.

DIAGNOSIS

Failure to diagnose cancer of the lip in the early stage is almost always due to the patient's indifference to a chronic, symptomless lesion, and not to an error of the family physician who is more apt to diagnose cancer when none is present. The diagnosis is usually easy, yet small, stationary, symptomless lip cancer can be overlooked even in the presence of a large cervical metastasis. (Figs. 2B and 5.) Keratosis may co-exist and be difficult to differentiate from the scaly type of

cancer. A chancre of the lip and an indurated erosion due to cancer may look and feel alike, but the history and type of patient are different. A positive Wassermann reaction does not identify the lip lesion as leutic. Cancer may arise in the lip or any other tissue in a patient with syphilis. The clinical diagnosis of cancer, with or without a positive Wassermann reaction, must always be confirmed by examination of a biopsy specimen, particularly if radiation treatment is chosen.

FIG. 4. A, on admission, submaxillary metastasis, stage III, from small cancer of the lip previously destroyed by "acid." The crusts of the skin were produced by *x*-radiation prior to admission; B, three months after neck dissection; patient died without signs of cancer two and one-half years after operation.

A hard, spherical, movable mass just below the point where the facial artery crosses the margin of the mandible, or just below the jaw margin in the midline, is usually a lymph node enlarged by the growth of cancer cells if it measures a centimeter or more in diameter. Microscopic examination of surgical dissection specimens, reported by many authors, proves that the correct diagnosis of metastases of nodes smaller than 1 cm. is luck, as there is a 50 per cent chance of error in diagnosis; lymph nodes which are not felt may contain cancer and small palpable nodes may be free of cancer. If found in any other part of the neck than the suprahyoid region, a single, spherical mass is rarely, if ever, a metastasis.

Fixation is the accepted criterion for classification of metastasis by stages and in relation to operability. A fixed node is called a stage III metastasis; a movable node is called a stage II metastasis. It is presumed that fixation always indicates invasion of the surrounding tissues by cancer. Fixation of a large submaxillary metastasis, not uncommonly associated with cancer of the lip, cannot, however, be accepted as evidence of invasion with the same assurance as fixation of nodes in other parts of the neck. It is probable that a benign submaxillary mass of the same size would be quite as fixed. An opinion regarding invasion and operability of this type of metastasis must, therefore, rest in part upon the rate of growth of the metastasis, the type and rate of growth of the lip cancer, the *x*-ray appearance of the jaw margin, the existence of invasion of the overlying skin, the presence of a palpable node margin, and the existence of the slightest degree of mobility of the suspected mass. Unquestionable invasion of the tissue surrounding a metastatic node appears as a diffuse, hard swelling, similar to a celluitis.

Before any type of treatment for metastasis is given a biopsy specimen from the suspected mass must show cancer. A biopsy specimen may be aspirated with a needle and syringe, cut with a Silverman needle, or excised with a knife. Microscopic diagnosis is needed to prove the presence of cancer; it is decidedly in the interest of the patient's welfare.

TREATMENT

Cancer limited to the lip has been successfully treated by surgery, *x*-ray, radium or electrosurgery, as well as by less approved methods. Any of the approved methods of treatment can be used to destroy a lip cancer; success depends upon the skilfull use of the method not on the method alone. Unless there is invasion of the mandible, the successful destruction of any lip cancer, irrespective of size, offers no therapeutic problem. The entire lower lip can be removed, if necessary, without impairment of the patient's health, even if the resulting defect is not closed by plastic surgery. However, before treating a small lip cancer as a trivial condition, one should remember that an insignificant lip cancer can produce large, incurable, cervical metastasis. (Figs. 2B and 5.)

The method of treatment chosen for a particular cancer of the lip depends upon the certainty with which it controls cancer, upon the rapidity of convalescence from treatment, and upon the cosmetic result. The method also depends upon the skills of the attending physician and the treatment facilities available to him. For the best cosmetic results small cancers of the lip should be excised and large ones treated by radiation.

Surgery is a more certain method of treatment for cancer of the lip than radiation because it does not depend for its success upon the unpredictable biological reaction of tissues to radiation, called radiosensitivity. Excision of a v-shaped piece of the entire thickness of the lip surrounding the cancer is a good type of treatment for a small cancer, not because it removes the lymphatics, but because the wound can be neatly closed and the cosmetic result is excellent. (Fig. 3B.) An operation consisting of the removal of the entire exposed portion of the lip alone (Fig. 3F) is suitable for treatment of small cancers and associated keratoses. If a fungating cancer which occupies most of the lip is excised, the resulting surgical defect of the lip must be closed by some kind of plastic operation, such as the use of Estlander's triangles (Fig. 3E), or cheek flaps. Surgery would appear to be a decidedly better type of treatment than radiation for the infiltrating type of lip cancer which invades the soft tissues of the chin. (Fig. 2F.) Stewart[5] devised an operation for this type of lip cancer in which the lip, soft tissues of the chin and suprahyoid lymph nodes are removed in one piece.

FIG. 5. On admission; diagnostic error; submaxillary metastasis; stage III; treated as an abscess; secondary to an unrecognized cancer of the lip shown in Figure 2B.

The lip cancer was excised in forty-one of the fifty-six patients studied; nine were successfully treated by radium and one by radium and surgery. Five cancers of the lip had been destroyed before admission.

TREATMENT OF CERVICAL METASTASIS

Prophylactic treatment of the lymphatics of the neck by surgery, or *x*-ray is not necessary because most cancers of the lip do not develop metastatic nodes. Follow up examination of the neck is a more ideal form of treatment.

Treatment of the metastasis is the important therapeutic problem in about 25 per cent of the cases of lip cancer. Although *x*-radiation is often used prophylactically and therapeutically, there are few reports except that of Martin[6] of five-year cures of microscopically proved

squamous carcinoma of the cervical lymph nodes by radiation of any kind. Squamous carcinoma of lymph nodes, secondary to by a therapeutic dosage of radiation are a contraindication to subsequent surgical dissection. The use of any kind of post-

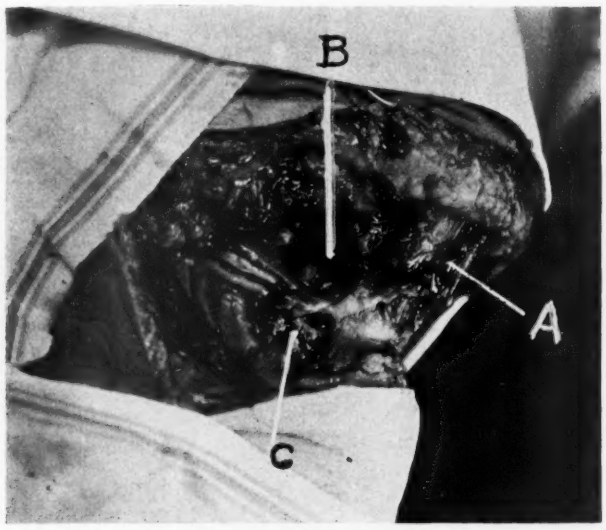


Fig. 6. Suprahyoid neck dissection (right side of bilateral operative field). Type of operation suitable for metastasis in submental or submaxillary triangle. A, submental triangle, anterior belly of digastric muscles on either side; B, submaxillary triangle, anterior and posterior belly of digastric muscle below, margin of mandible above; C, carotid triangle, omohyoid muscle in front, sternomastoid muscle behind.

cancer of the lip, is almost never destroyed by the maximum amount of *x*-radiation which the skin will tolerate. Martin usually supplements *x*-radiation with the implantation of radon seeds. The amount of radiation furnished from these combined sources will probably destroy squamous carcinoma in lymph nodes or elsewhere in the body and will produce some five-year cures in that class in which the metastasis is forever limited to one or possibly two nodes of moderate size. The success of the method depends upon the non-appearance of new metastatic nodes in the implanted area and lower in the neck. In this method of treatment a cancerocidal dosage of radiation is limited to the palpable metastic nodes and is not given to a margin of normal lymphoid tissue. Martin's method, and that of Evans',[7] which consists of the implantation of radium needles throughout the entire side of the neck is indicated in patients who are poor surgical risks. The change in the tissues of the neck produced operative radiation is indicated only in the cases in which the operability of the metastasis has been misjudged.

The removal of a margin of normal tissue surrounding any cancer is a fundamental principle of surgery. Intelligent application of this principle to the treatment of metastasis requires the recognition of all the metastatic nodes and the removal in one piece of the metastatic nodes and the normal nodes below those containing cancer. Enucleation or local excision of metastatic nodes is poor surgery. The field of surgical dissection is, therefore, determined by the location and extent of the metastatic nodes. The superhyoid dissection commonly performed is an operation limited to the submaxillary and submental triangles. It is a prophylactic operation inadequate for the control of cancer if metastatic nodes are present in these triangles. Metastastic nodes in the submaxillary or submental triangle require the dissection of at least the carotid tri-

angle of the same side of the neck (Fig. 6) to secure a surgical margin of normal lymph nodes and lymph vessels beyond the

Metastatic cancer which destroys bone is incurable by any method of treatment because it spreads rapidly even if destroyed

Fig. 7. Lateral neck dissection (left side). Type of operation suitable for metastasis in the carotid triangle. The posterior belly of the omohyoid muscle marks the lower limit of the field of dissection. A, submaxillary triangle of the neck; B, carotid triangle of the neck; C, occipital triangle of the neck (middle two-fourths); D, subcutaneous margin of the body of the mandible; E, digastric muscle, posterior belly; F, hypoglossal nerve, crossing the external carotid artery; G, internal jugular vein, ligated upper stump; H, carotid bifurcation with descendens hypoglossi nerve on its anterior surface; I, vagus nerve; J, upper stump of sternomastoid muscle and cut surface of parotid gland; K, region of the tendon of omohyoid muscle; L, position of lower stump of sternomastoid muscle and lower stump of ligated internal jugular vein.

metastastis. A certain percentage of failures will occur in any series of cases if a surgical margin of lymphoid tissue is not removed and if a lateral neck dissection (Fig. 7) is not done at once, if microscopic examination of the surgical specimen from the suprahyoid region shows unsuspected cancer in the nodes of the submaxillary region.

locally. But in some other types of stage III metastasis, the question of operability cannot be answered without meticulous examination and careful study of all aspects of the disease. Surgery may offer the patient with a stage III metastasis the best chance of survival.

When metastasis is confined to one large submaxillary node (Figs. 4A and B),

the slow growth of the metastasis, its low histological grade and its suprahyoid location, as well as the controlability of the lip cancer justify the performance of a neck dissection which would be contraindicated in a stage III metastasis from a primary cancer of any other site than the skin of the face. Fewer deaths will follow operation for large submaxillary metastases if a piece of the full width of the body of the mandible is not removed. Questionable areas of bone invasion can be charred with an electrocautery and the sequestrum allowed to separate.

Fortunately, bilateral submaxillary metastases from lip cancer are not necessarily simultaneous. A difference in the time of appearance of nodes on the two sides of the neck permits convalescence from one neck dissection before operation is needed on the other side of the neck. Bilateral neck dissection is probably more often done in conservative surgical clinics for metastasis from cancer of the lip than for metastatic cancer from any other tissue.

The treatment of the metastases which developed in twenty of the fifty-six patients studied, is as follows: surgery alone, twelve cases; surgery and *x*-radiation, four cases; surgery and radium, two cases; radium alone, one case; *x*-ray alone, one case.

PROGNOSIS AND RESULTS

Lip cancer, which never metastasizes, has an excellent prognosis; of the thirty-six patients studied, 83 per cent lived five years or longer. (Table III.) If the health of patients with this type of lip cancer were better, it would appear possible to attain five-year cure rates of 100 per cent.

Cervical metastasis is usually the cause of death from lip cancer. Table III shows a five-year survival of 15 per cent of the patients who had metastasis (stage II and III), and a five-year survival of 83 per cent of those who never had metastasis.

No single aspect of an individual lip cancer can be used as an infallible guide to prognosis but, as a group, more patients with a small cancer (Table I) and with grade I cancer (Table II) lived five years. Small cancers (Table I) and grade I cancers (Table II) metastasize less often than lip cancers of high histological grade and those of large size.

The prognosis of metastases from cancer of the lip is better than that of metastases from cancer of the mouth or the throat. About one-fourth of the patients with movable, stage II metastasis, lived five years; three of thirteen patients, 23 per cent. Of the seven patients with fixed, stage III metastasis, none lived five years. (Table III.)

SUMMARY

Cancer of the lip is a slowly growing squamous carcinoma, grade I or II, of the exposed surface of the lower lip of aged men. Carcinoma of the upper lip and carcinoma of the lip of a woman are medical curiosities.

One lip cancer in four metastasizes to the cervical lymph nodes; visceral metastases are rare.

A large cancer or a cancer of high histological grade is more apt to metastasize than a small or low grade cancer, but metastasis of a particular cancer irrespective of size or grade cannot be predicted accurately.

Death is caused by uncontrolled neck metastases not by cancer of the lip itself.

X-ray, radium or surgery can be used successfully to destroy the cancer of the lip.

If the patient is cooperative, any kind of prophylactic treatment of the cervical lymphatics is unnecessary; follow-up examinations are preferable.

Movable metastatic nodes are treated, by choice, with block dissection of the cervical lymphatics.

Fixation of large submaxillary metastasis from lip cancer is sometimes due to tension of the walls of the submaxillary space rather than the invasion of the mandible or floor of the mouth. This type of fixed metastasis is operable.

The cancer cells in lymph nodes can be destroyed by the combined effect of *x*-radiation and radon implants, rarely if ever by external radiation alone; but the disease in the neck will be cured by combined radiation only if no new metastatic nodes develop in the implanted area or elsewhere in the neck.

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Streptococci are Gram-positive organisms, which grow in chains and comprise many different strains. Also members of the same strain often develop varying degrees of virulence.

DIAGNOSTIC VALUE OF BLOOD STUDIES IN MALIGNANCY OF THE GASTROINTESTINAL TRACT

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THE present study was undertaken with the primary objective of developing data which might furnish a valuable diagnostic adjunct in uncovering malignant disease of the gastrointestinal tract. Thirty selected cases were examined, seventeen in males, thirteen in females. In two instances the cancer was in the small intestine, seven in the colon, two in the sigmoid, one in the rectum, and eighteen in the stomach. The majority of the patients were in the older age group, and a number of specimens were obtained from each patient. In Table 1 the blood count, differential count, sedimentation rate and platelet count are recorded.

Examination of the blood smears in these cases failed to reveal any hematologic features that were unusual or in any way diagnostic of the existing condition. The majority of the patients presented an essentially normal blood picture, although abnormal cells appeared occasionally. In both early and late stages of malignancy, no significant changes were noted, except in those cases in which extensive ulceration had occurred. In these cases a distinct leucocytosis was found. The platelet counts were within normal limits, since the normal value for platelets, according to most hematologists, ranges from 200,000 to 400,000. Only two counts rose above this figure.

It was evident, however, that the blood sedimentation rate was abnormal in all cases. Also, the two-hour period was more reliable and, therefore, conclusions were based on the second reading. In these determinations a rate of 10 mm. for men and 15 mm. for women was considered the upper limit of normal. Lipp and Aaron[1] adopt the following scale:

Sex	Normal	Borderline	Elevated
Male	1–10	11–15	21+
Female	1–15	16–20	26+

Inasmuch as the rate was faster in solutions of fibrinogen, and slower in solutions of albumin, according to Fahraeus,[2] Broom,[3] and Lima and Brown,[4] the tests were also made with albumin. But in all of the experiments, the author found no change in the sedimentation rate; the results were the same as those obtained when the Cutler technique was employed.

In this series, as has been repeatedly noticed by other investigators, the analysis of the blood showed no striking characteristics. As Edwards[5] points out, if we assume the blood count to be an index of a patient's fitness, we may be sadly deceived. In many of the inoperable cases the red count and hemoglobin may remain rather high, or at least average normal:

"In a man of 49 with an inoperable growth, the red count was 6,560,000 and the hemoglobin 104 per cent, and in a woman with an inoperable growth it was 6,100,000 with 92 per cent hemoglobin. In fact, changes in the blood picture in cases of cancer usually differ very little from those of peptic ulcer."

The increase in the sedimentation rate, however, was of some significance, since it indicated that a disease of some kind was present. In 1927, Rubin[6] examined the blood sedimentation reaction in 127 cases of cancer and found this medium a better guide to the condition of the patient than the temperature chart. The progress of the disease was accompanied

by an increased sedimentation rate, although cachexia tended to retard it. The test, however, had no value in differential diagnosis because of its non-specificity and because early cancer produced little alteration in the velocity. It was noted that strictly normal sedimentation values were extremely rare in the presence of definitely diagnosed cancer. This is ascribed to physiochemical changes in the blood plasma and to the progressive anemia in cancer patients.

TABLE I

GASTROINTESTINAL MALIGNANCY

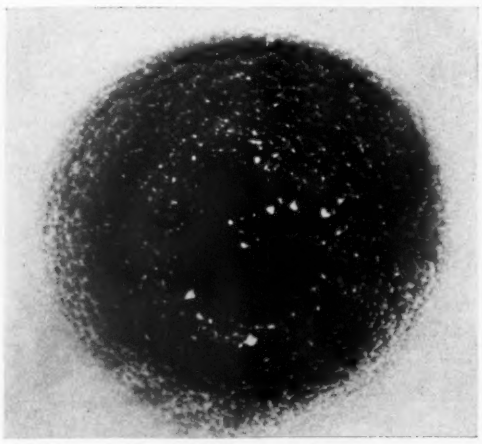
Sex	Age	Site	Hemoglobin (Sähli) Per Cent	Erythrocytes	Leucocites	Neutrophiles	Small Lymph.	Large Lymph.	Sedimentation		Platelets (thousands)
									1 H.	2 H.	
M	39	Sigmoid	85	4.65	6,000	67	30	3	18	24	285
F	62	Colon	60	3.75	6,000	65	33	2	18	26	240
M	66	Stomach	60	3.70	10,600	68	30	2	20	28	245
F	62	Colon	50	3.25	9,000	74	25	1	26	34	240
F	58	Colon	70	3.60	8,000	65	33	2	24	30	265
F	53	Colon	70	3.60	7,800	66	33	1	21	29	300
F	78	Stomach	55	3.25	11,200	74	24	2	22	28	220
M	70	Stomach	80	4.65	6,200	68	25	7	24	30	240
M	73	Colon	55	3.55	11,000	86	12	2	24	32	250
M	61	Stomach	45	2.16	9,000	62	32	6	22	32	210
M	52	Intestine	70	3.85	20,000	94	6	0	18	24	280
F	72	Stomach	70	3.85	6,000	64	35	1	21	28	325
F	84	Stomach	75	4.50	12,000	76	21	3	24	32	400
M	64	Intestine	80	4.30	15,000	84	12	4	28	34	450
F	87	Stomach	50	2.75	7,000	78	20	2	22	30	340
M	51	Colon	50	3.50	11,600	80	18	2	24	28	290
F	72	Stomach	50	3.00	6,000	45	50	5	18	26	375
M	62	Stomach	80	4.30	11,000	85	12	3	16	24	400
M	68	Stomach	55	3.25	8,200	80	16	4	18	26	340
M	68	Stomach	50	3.50	24,000	90	5	5	20	28	300
M	73	Colon	75	4.25	13,000	90	8	2	24	28	370
M	71	Stomach	65	3.90	3,200	82	14	4	18	24	300
F	69	Stomach	40	3.15	12,000	85	10	5	18	22	290
M	70	Stomach	80	4.50	6,400	74	25	1	20	26	320
F	47	Sigmoid	60	3.25	7,400	60	35	5	24	32	375
F	67	Stomach	75	4.25	8,000	80	10	10	22	26	325
M	41	Stomach	70	4.10	7,200	72	25	3	18	26	300
M	70	Stomach	70	4.00	11,000	78	20	2	21	26	280
F	82	Stomach	80	4.50	19,400	90	5	5	22	26	300
M	59	Rectum	60	3.50	8,300	82	15	3	18	26	420

None of the factors listed above are specific for cancer. Therefore, we are forced to rely mainly upon the blood pattern, as described in a previously published article,[7] to reveal the presence of malignant disease. Further study has reëmphasized the fact that blood taken from a person suffering from cancer assumes a different picture from that taken from a normal person. After assembling many additional blood slides in conjunction with the clinical picture, it has now become possible to recognize a definite new pattern, that of beginning malignancy.

In preparing the drops of blood on the glass slide, lightness of touch is essential; for if the drops so acquired are too thick, no pattern is discernible. When the blood has dried satisfactorily, the pattern formed is a sensitive indicator and can be used at intervals to determine the course of the

disease, presence of metastasis, and end results after surgery, deep *x*-ray therapy, or radium implantation.

The clinical picture and physical signs should not be ignored in weighing the evidence. The condition of the patient



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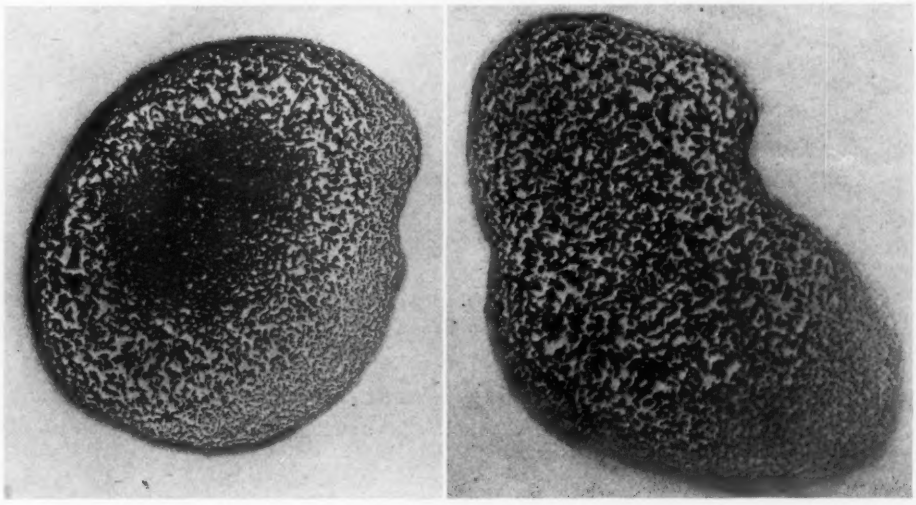


B C

FIG. 1. A, normal pattern; B, pattern of early malignancy; C, pattern of late malignancy (gross appearance).

In Figure 1 we note three distinct patterns: A shows the normal blood pattern. The design is compact and in the central portion of the drop of blood is a dark agglutinated spot or nucleus. B shows the pattern of early carcinoma, with a breaking-down of the pattern at the periphery. The small central nucleus is absent, and the central half is much darker than the outer portion of the sphere. C shows the definite cancerous pattern of the "dotted curtain" type, creating the appearance of ground glass. No central nucleus is visible.

appears to run parallel with the patterns on the slides. In the words of Gruner:[8]

"The state of the red cells gives more information about the state of the patient than almost any other part of the blood examination."

In this special description of the wet preparation of normal and cancerous blood the same picture is apparent as that noted in the dried specimens. In this monograph he stated that the work of the past twenty-seven years proved that the study of the blood cells as a diagnostic test gave results unsurpassed in accuracy.

The author has attempted to simplify the method of diagnosis by noting the blood pattern both macroscopically and microscopically. The photomicrographs of cancerous blood are the same as those noted by Gruner.

The microscopic examination of the normal pattern reveals fibrin formation well defined—a web-like pattern. Leucocytes are scarce and red cells are packed tightly. Rouleau formation is present with no variation is the size or shape of the corpuscles. Fibrin is plentiful and extended over the whole specimen.

In the early carcinoma pattern small areas of clear plasma are scattered throughout the specimen. A few granules may be seen but no blood cells. The fibrin meshwork is not so definite as in the normal pattern.

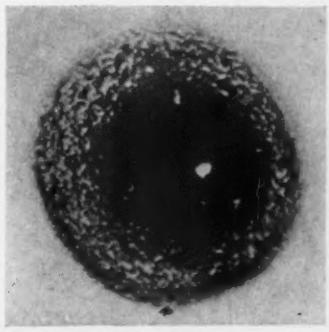
In the full-bloom or advanced carcinoma picture large areas of plasma are visible and no red blood cells. No meshwork is found but the picture is that of relatively thick islands or masses with sharply defined contour. Leucocytes are rarely seen. An abundance of small fibrin threads appears. Within the plasma small red and green granules are found. The outline of the red cells is obscured and no real rouleau formation can be noted. The change appears to take place in the fibrin, resulting in large areas of plasma devoid of red blood cells. Thus, from this study, three distinct blood patterns emerge:

1. *Normal:* characterized by the appearance of well formed fibrin strands varying in size and thickness and crossing one another in all directions so as to form a fibrin web enmeshing the corpuscles.

2. *Early carcinoma:* showing the change in fibrin formation and the presence of small areas of plasma without red blood cells.

3. *Carcinoma:* definite marked change in fibrin formation and the presence of large areas of plasma and absence of red blood cells. This pattern is constant in cases of malignancy and has no relationship to anemia when present.

The two following cases illustrate the efficacy of the blood pattern as a diagnostic aid. In Case 1 the first specimens



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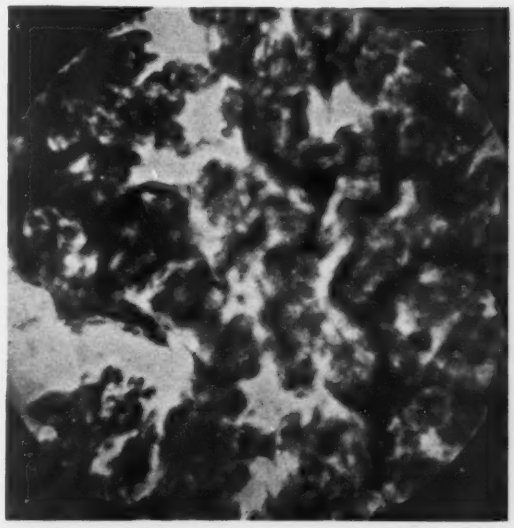


B

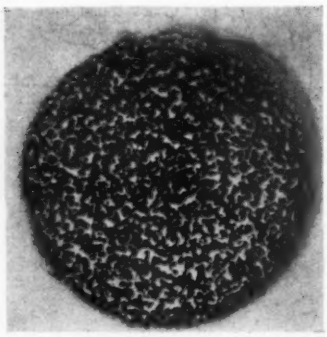
FIG. 2. A, adenocarcinoma of rectum, early stage; B, microphotograph of same drop of blood on slide. Note small lakes of plasma.

show early carcinoma and later on the full-bloom pattern. Many slides were made which show close correlation with the course of the disease until the final exitus.

CASE 1. J. O., male, age fifty-nine years, was admitted to the Fall River General Hospital May 2, 1942, with the complaint of pain in the abdomen for six months, accompanied by vomiting and diarrhea. There was generalized tenderness over the entire abdomen, most marked in both lower quadrants. Examination of the heart and lungs showed no abnormalities.

Urinalysis showed a specific gravity of 1.025, a slight trace of albumin and no sugar. Microscopically, the urine showed a very occasional

leucocyte and a red blood cell. Examination of the blood showed 60 per cent hemoglobin, 3,500,000 erythrocytes, 8,300 leucocytes with



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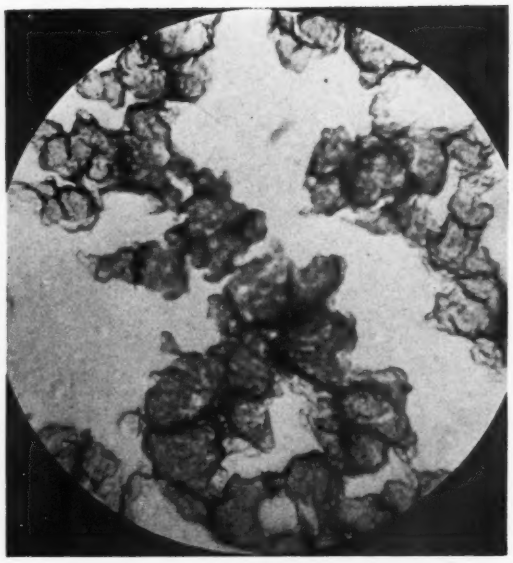


B

FIG. 3. A, gross appearance of drop of blood, full-bloom carcinoma; B, microphotograph of same specimen. Note large areas of plasma with few blood cells.

82 per cent neutrophiles, 15 per cent lymphocytes, 2 per cent eosinophiles, and 1 per cent basophiles. The platelet count was 420,000. The blood sedimentation rate was 18 mm. in one hour; 26 mm. in two hours.

A drop of blood on the slide showed the pattern of early cancer. (Fig. 2A.) This specimen was taken May 8, 1942. At this time the breaking-down process at the periphery can be seen grossly. Under the microscope the lakes of plasma are seen shaping up. (Fig. 2B.)

A gastrointestinal series at this time showed poor filling of the duodenal cap with obstruction in the left side of the colon. Sigmoidoscopic examination showed a small elevation in the rectum about 5 cm. from the anus. This bled easily. No tissue was removed for biopsy, but a tentative diagnosis of malignancy was made.

One month after admission an exploratory laparotomy was done and the entire intestinal tract examined. The small elevation noted on sigmoidoscopic examination could not be located. Instead, the mucosa of the colon showed several areas of diffuse ulceration and superficial hemorrhage. About 21 cm. of descending colon was resected and a colostomy set up. The pathological diagnosis of the specimen removed was chronic ulcerative colitis, non-specific; no evidence of malignancy was found.

On June 11th, examination of the blood showed 60 per cent hemoglobin, 3,600,000 erythrocytes, 6,600 leucocytes with 67 per cent neutrophiles, 30 per cent small mononuclears, 2 per cent large mononuclears and 1 per cent eosinophiles.

Attempts were made to close the colostomy during the patient's stay in the hospital. On November 11th, a small spur was clamped with three different clamps to the level of the lower end of the bowel canal. This cut through in three days. Then a large, soft, rubber No. 28 bladder drainage tube was placed *in situ*, one-half of the tube above and one-half below the colostomy. The tube was then connected by a suture of heavy silk to a small rubber tube on the rectal side brought out through the anus. On placing the latter tube in position, an annular constricting neoplasm was discovered in the rectum.

A drop of blood on the slide at this time, November 15th, showed the pattern of advanced carcinoma. (Fig. 3A.) The microphotograph of this specimen of blood shows great lakes of plasma. (Fig. 3B.)

On April 16, 1943, an abdominoperineal resection of the rectum was done. As a therapeutic measure, 15 gr. of sulfasuxidine was administered three times daily for about a week before operation was undertaken. It is interesting to note that peritonitis did not develop in the presence of degeneration, necrosis and drainage of feces into the peritoneal cavity.

The specimen removed consisted of about 10 cm. of terminal rectum containing the tumor mass. (Fig. 4.) The pathological diagnosis was adenocarcinoma of the rectum.

The patient went steadily downhill after this operation and died May 9, 1943. Many

blood slides were taken during this late stage of the illness and all showed the pattern of advanced carcinoma. The last of these slides was taken May 5th. Permission for a postmortem examination in this case could not be obtained.

Fig. 4.

Fig. 5.

Fig. 4. Specimen of adenocarcinoma of rectum removed April 16, 1943.

Fig. 5. Cyst of omentum removed April 23, 1943.

It is interesting to observe that the pattern of early carcinoma appeared in the blood pattern on the slide at a time when surgical exploration of the gastrointestinal tract revealed no trace of cancer, and when the only condition found and confirmed by pathological examination was ulcerative colitis.

In this second case the blood pattern remained consistently negative, although clinical and *x*-ray evidence pointed strongly to malignancy.

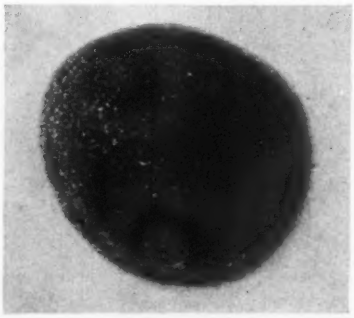
Case II. R. G., female, single, twenty-seven years old, a power sewing-machine operator, was admitted to a local hospital April 22, 1943, for abdominal pain and rectal bleeding. Except for an appendectomy in 1932, she stated that she had never felt ill until the present complaint. For the past year, however, she has passed quantities of blood rectally. Her bowel movements had been regular and she never needed catharsis. Menstruation was regular and painless; periods lasted about seven days. For the past year, however, she passed blood almost continuously and the discharge was profuse. During the past three weeks she had severe colicky pains and an impulse to move her bowels. When she strained, blood would gush out with relief of the pain for several days; then the cramp-like pain would recur. Bowel movements were normal. There were no urinary symptoms.

The general physical examination was negative except for slight tenderness and spasticity in the left inguinal region. Rectally, a soft, flabby mass was felt on the anterior wall of the rectum in the region of the pouch of Douglas. Sigmoidoscopy revealed a mass covered with mucous membrane. It was painful on palpation but did not bleed. By vaginal examination the mass was palpable in the posterior vaginal wall. The uterus and cervix were normal.

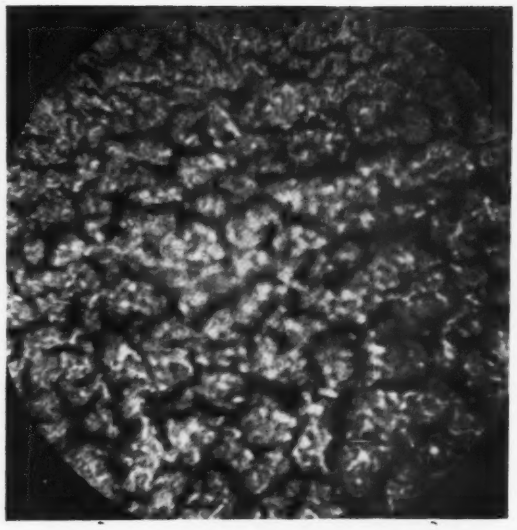
A gastrointestinal series, April 12th, was negative. A barium enema filled the large bowel completely. An oblique view of the rectal ampulla showed a smoothly outlined convexity, identified as the hard, tender, dome-shaped mass felt by the examining finger. The impression was extrinsic pressure defect in the anterior rectal wall (neoplasm or inflammation).

Urinalysis and blood examinations were negative. The stool contained no occult blood.

On the second day, under spinal anesthesia,



A



B

FIG. 6. Case II. A, blood pattern normal, April 22, 1943, before operation; B, microphotograph of blood pattern showing normal picture.

vaginal examination revealed the same findings. Dilatation of the cervix was attempted. It was found almost impossible to pass the smallest dilator through the cervical canal. This was finally accomplished, and a stricture or spastic area was noted about 3 cm. from the external os. The uterus was gently curetted, but the curettings were negative.

Exploratory laparotomy revealed the terminal portion of the omentum in the pouch of Douglas. In the omentum was found a serous, translucent cyst about the size of a large apple. (Fig. 5.) This was excised *in toto*. After this procedure manual examination of the rectum revealed a soft, flabby area in the rectum at the pouch of Douglas. A few postappendiceal adhesions were present. The ovaries were normal; there was a bilateral chronic salpingitis.

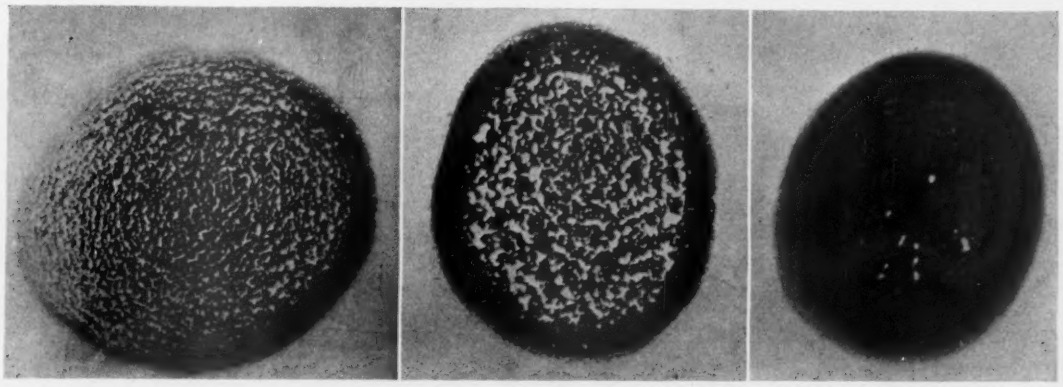
The pathological report of the specimen removed was simple omental cyst.

All specimens of the blood on the slides taken before and after operation were of the normal blood pattern. (Fig. 6A.) The microphotograph shows the closely packed red blood cells and rouleau formation and a substantial amount of fibrin throughout the specimen. Very few leucocytes are seen. (Fig. 6B.)

The change from a normal to a cancer pattern has not been explained through pathological or clinical investigation. The answer may lie in the behavior of the plasma. We know that it participates in many chemical reactions and maintains itself in constant acid-base equilibrium It is adapted to every need of the body cells and tissues.[9] The changes in the plasma may be quantitative or qualitative or both. It is an interesting fact that during pregnancy there is an increased amount of blood and plasma present.[10] Dieckman and Wegner[11] also point out the fact that a high percentage of fibrin is found whenever foreign proteins enter the blood stream, as in cancer, infection, and nephrosis.

The same pattern is formed on the slide by cancer blood and by the blood of pregnant women. The change taking place in the blood during pregnancy has been observed from the first month on. Just before delivery the pattern is broken down to such an extent that the picture is typical of advanced carcinoma. Areas of plasma without blood cells are conspicuous. From the fourth day of the puerperium the blood begins to revert to normal. Each day the areas of plasma become smaller, strands of fibrin gradually begin to criss-cross in various directions throughout the field, and by the tenth to the twelfth day postpartum, the blood pattern is normal and remains so. This same return to normal is seen in cases of cancer in which total extirpation has been achieved, although the process takes about six weeks. Figure 7 shows the blood picture in pregnancy which both macroscopically and microscopically is identical with that seen in cancer. Figure 7A shows the typical cancer pattern (specimen was taken during the eighth month of preg-

nancy). Figure 7B was taken eight days postpartum. The blood pattern is still positive, but changes are beginning to occur at the periphery. Figure 7C, taken two months following delivery, shows the normal blood pattern.



A B C

FIG. 7. A, pattern positive taken during eighth month of pregnancy; B, pattern still positive taken eight days after delivery; C, pattern normal taken two months following delivery.

Girón[12] tested 515 cases, consisting of 150 cancerous individuals and 365 non-cancerous patients and healthy subjects. In each case six drops of blood were examined—total number of drops of blood examined, 3,090.

In the cancerous patients, the typical cancer pattern was found in 90.4 per cent of the cases. In non-cancerous subjects the drop of blood showed the typical cancer pattern in 4 per cent of the cases.

In evaluating the results obtained, Girón states that they closely approximate the results obtained by the author of the test.

CONCLUSION

The accumulation of additional slides further substantiates the correlation between the blood pattern and carcinoma. The increase in the blood sedimentation rate is also of diagnostic aid but is non-specific and of only general significance. None of the other phases of the examination of the blood furnish a clue to the presence or absence of cancer. The small number of cases taken at random are typical. The blood pattern noted in a drop of blood on the glass slide continues to offer the internist substantial aid in diagnosing cancer in various stages and to differentiate between benign and malignant conditions.

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MODIFIED NON-ADHERENT GAUZE PRESSURE TREATMENT FOR BURNS

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THE purpose of this study was to employ a modification of the Koch, Mason and Allen pressure treatment of burns with the use of a new ointment* which would form a non-adherent coating over such wounds and would render the injury practically sterile. Various sprays and sulfa powders have been employed to form an eschar over such wounds, but these have proved to be rather painful and non-supple. Furthermore, it was our hope to evolve a simple treatment for burns which could be employed by the now undermanned hospital staffs. Also, the present study could serve as a postlude for the application of some principles which Marshall and Rosenthal[1] described in their recent study on the pathogenesis of keloids, since such new growths many times have their origin in burns, especially in patients of the colored race.

These investigators found that tissue fluid exudations, if allowed to remain in the tissue spaces as the result of injury, attract the fibroblasts which invade the injured area. Later on, the proliferation of scar tissue occurs. Previously, Marshall[2] had noted that vasoconstriction of wound areas tends to improve healing. This confirms the pressure gauze methods of Koch, Mason and Allen who have advocated a pressure compression bandage of vaseline gauze over burned areas to lessen the flow of tissue exudates. In some unpublished research, Marshall found that plain gauze, when fixed to the wounds of surgical patients by means of catgut sutures, tends to allow such wounds to heal more rapidly with the added feature of the formation of a supple non-keloid scar when the healing is completed, since this compression does not allow a tissue edema to remain in the surgical area.

The rôle of the sulfonamides in wound healing has been established, particularly in the prevention of wound infections. Sulfanilamide has the greatest solubility in the tissue fluids of all the sulfonamides. Sulfathiazole ranks considerably below it.

This new ointment, used in the course of the present study, contains 2 per cent allantoin with 5 per cent sulfanilamide and 5 per cent sulfathiazole. The material is water soluble and is miscible with the body fluids and releases these effective agents readily into the infected burn areas.

The solubility of sulfanilamide is such that in all probability it is depleted from the site of application within forty-eight hours. Since the process of redressing may interfere with adequate wound healing, and since the tiny capillary buds may be disturbed by such a procedure, the incorporation of sulfathiazole in the paste was completed. This additional ingredient would allow effective concentration of a sulfonamide over a much greater period than would be secured by sulfanilamide alone. This addition to the paste (sulfathiazole) proved to be an important step as the data will show.

Another point may be important to mention. Some papers have appeared in the literature[3,4,5,6] which seem to show that urea counteracts the sulfonamide inhibitors. Since allantoin forms the basic paste for this combination of sulfonamides,

*The ointment used in this experimental study is Allantomide with Sulfathiazole and is manufactured by the National Drug Company of Philadelphia.

it may be, at least partially, responsible for the destruction or blockage of the sulfonamide inhibitors through the urea which it contains. It is claimed that allantoin has the ability to exercise a chemical débriding effect on necrotic cells (such as are present in burn areas); it acts also to increase cell proliferation which stimulates healing.

Andrus, Nickel and Schmelkes[7] used hydrated films prepared from a hydrophilic cellulose derivative in which various chemotherapeutic agents were incorporated. Since these films are transparent, these workers could observe the healing processes of burns which were treated with 10 per cent sulfanilamide and buffer, with and without quantities of azochloramid. The longest time elapse required for complete healing was twenty-one days. These investigators treated burn wounds by débriding and cleansing with a solution of sodium chloride, boric acid, or azochloramid and sodium chloride as thoroughly as possible. Aseptic technic is followed closely. The preformed membrane is directly applied to the raw oozing surface of the burn. A dry sterile dressing is placed over the membrane and held by plain gauze bandage. New membranes are added when needed.

Hamilton[8] treated 199 burns with topical applications. He used Foille, tannic acid, sulfadiazine and cod-liver oil. He found no difference in their value as to saving life. He noted that superficial burns heal kindly whatever the local application, but Foille was superior to these other agents as a dressing for deeper burns in that it was more simple to apply; it reduced the healing time of third degree burns; it acted as a detergent for grease and oil, and it formed a soft, mildly antiseptic, easily changed coating, ideally suited to infected burns, to burns of the face, hands and genitalia and to the sloughing stage of third degree burns.

Weaver[9] stresses the point that successful treatment of burns is due to the careful preparation of the wound and the alert, painstaking after-care, rather than the specific type of application. He believes that all burns should be considered infected when six or more hours have elapsed. Weaver advises the immediate thorough cleansing and débridement of burns, using white bar soap, large cotton swabs and an abundance of warm water, just as soon as the patient's condition will permit it. This seems to be in accordance with Allen and Koch's method. Weaver advises the use of a spray of triple dye; each coat is dried with a warm air dryer. The patient is then returned to bed between sterile sheet, under a warm cradle. Weaver advises against the use of coagulants in infected wounds.

Ravdin[10] states that the pressure dressing method has much to commend it. One of the sulfonamides, in the form of an ointment, can be placed on the burned area following débridement and the part firmly supported and bound. Plasma loss is decreased by this method, and the patient remains comfortable; further tissue injury is minimized and subsequent dressings are kept at a minimum. He advocates that a third degree burn be skin grafted as soon as possible, for this will reduce the incidence of infection, as such burned areas invariably become infected if not grafted.

Harkins[11] concludes that tanning is a reliable method for burns of the trunk and flat surfaces of the body while the use of sulfonamides, Bunyan envelopes and ointment-pressure dressings will be useful in many war burns. The primary treatment of any severely burned surface is incomplete until epithelial tissue has completely closed the burned area. The speed with which this is accomplished, as well as the comfort of the patient, and the attainment of a low mortality rate, are three important indices of the efficacy of any method of local treatment of burns.

Allen[12] has advocated the liberal use of soap and water followed by sterile vaseline gauze pressure dressings with early grafting. Koch used the same technic with

adequate results. Siler and Reid[13] confirmed this technic upon 137 patients who suffered a mortality rate of 3.7 per cent.

Clark and his associates[14] used penicillin in the form of a cream for the treatment of fifty-four burns and scalds with a view to the elimination of hemolytic streptococci. In forty-one of these wounds, (76 per cent) these organisms disappeared within five days and did not reappear. In seven instances the strains which promptly disappeared were insensitive to sulfonamide. Penicillin appeared to have a good effect in all cases and staphylococci, too, disappeared quickly from many of the wounds. Healing was rapid and no toxic effects were observed. Propamidine was also applied in the form of a cream (0.1 per cent) to thirty-four similar burns. Hemolytic streptococci disappeared within five days from twenty-one of the wounds (sixty-two per cent). In eight cases, however, they persisted during treatment with propamidine, and healing was rapid with this material. Coliform bacilli, when present in the wounds, were apparently not affected by either of these agents.

Meyer and Gradman[15] made a comparative study between sulfadiazine spray and non-adherent pressure dressing treatment of burns (Koch's method). They found that the spray may re-infect these wounds, healing may be incomplete, and second degree burns may be transformed to those of third degree. Besides, this method was more painful than the non-adherent pressure dressing. Koch's teaching is advocated, namely, convert all burns from contaminated wounds to clean wounds by aseptic and atraumatic cleansing with soap and water. Second, keep them closed and clean until healing occurs.

Author's Method of Treating Burns. The usual technics of treating shock are employed where necessary. As soon as possible, all burns are gently washed with very mild soap suds. This is followed by several rinses with sterile water. Débridement of necrotic tissue with the opening of blebs follows the bathing process. Extreme care is taken to handle the burned areas in the most careful manner. The surgeon's hands should not touch the involved areas; sterile forceps are used to handle the gauze sponges during the washings.

If the patient is in near shock, or if actual shock is present, this is treated immediately before any manipulations are attempted.

After the wound has been cleansed thoroughly and carefully, and débridement has been carried out, the wound area is dried carefully with sterile towels. Care is taken not to rub the burned area. Gentle pressure with an ample number of towels will dry the area.

A sterile wooden tongue blade is used to apply the special ointment directly on the burn. A copious amount is employed. If it does not remain on the wound, another copious amount of the ointment is spread on a thick sterile gauze pad which is applied directly to the wound which is covered thoroughly along with the adjacent normal skin areas. Gentle, but firm, pressure with roller bandages, if practicable, is applied. This pressure serves two purposes: It causes a partial ischemia of the burn area which appears to aid in the healing process,[1] and the pressure helps to prevent the leakage of blood serum which, where allowed to escape in excessive amounts, may produce shock.

If the burn happens to be on an arm or leg, the bandaged arm or leg wound is splinted to assure rest which promotes more rapid healing, or if possible, the patient is kept at complete rest in bed for a week, at the end of which time the wound is redressed.

Many times the nursing staff and the patient will complain of the stench which is produced by the fermentation of protein products in the wound. This can be avoided by placing a waxpaper roll around the dressing and then an application of gauze is made which has been soaked in Dakin's solution.

During the time of the first dressing, the patient seems to be very comfortable.

Pain subsides usually with the application of the ointment. If a Curling's ulcer has not developed, the patient is given a general diet which has been fortified with the addition of 8 oz. of fresh orange juice with each meal (vitamin C content).[2] If this is not practical, for one reason or another, 1 Gm. of ascorbic acid, in divided doses, is administered daily with the diet.

When the first dressing is changed, the injured area is soaked again very gently in soap suds for about fifteen minutes. This is followed by a rinse with sterile water which removes the remnants of the ointment which have adhered to the burned area. The wound is then covered with the medication as has been described previously. It is not necessary, usually, to wait a week for subsequent dressings. These may be changed within five days or so, and the same procedures are repeated until the wound has healed completely. (Table 1.)

TABLE I

Name, Age	Type of Injury	Complications	Length of Treatment	Results
S. C. (col.) Age—37	3rd degree burned hands	None	6½ wk.	Complete healing; no scars
J. C., Jr. Age—6 mo.	3rd degree burns both feet	None	7 wk.	Complete healing; no scars
E. W. Age—42	1st degree burn side of face	None	2 wk.	Complete healing; no scars
R. D. Age—58	2nd and 3rd degree burns neck and chest	Unknown—Patient insisted that dressings be changed daily. Patient very unco-operative and released for private care from service in City Hospital		Unknown
C. J. Age—60	3rd degree burns of hands and arms	None	7½ wk.	Complete healing; no scars
B. B. (col.) Age—27	Ulcer from iodine burn on leg	None	3 wk.	Complete healing; no scars
A. P. Age—41	Ulcer from gasoline burn on hand	None	4½ wk.	Complete healing; no scars
B. R. Age—29	2nd degree burn of hands	None	5 wk.	Complete healing; no scars
R. L. (col.) Age—33	2nd and 3rd degree burns of neck, back, both hands and arms	None	4½ wk.	Complete healing; no scars
H. M. Age—16	3rd degree burn of back	None	3½ wk.	Complete healing; no scars
J. W. Age—37	2nd and 3rd degree burns of hands, face and chest due to burning gasoline	None	4 wk.	Complete healing; no scars
B. G. Age—7	2nd degree burns of hands	None	2 wk.	Complete healing; no scars

SUMMARY

A modification of the Koch, Mason and Allen compression treatment of burns is described.

It is believed that this method is simple to administer. It gives the patient immedi-

ate comfort and therefore lessens pain and also shock. The pressure, produced by the compression bandaging, tends to prevent the formation of keloids.

Twelve patients with various degrees of burns have been treated with this method. Eleven patients have shown no signs of keloid formation and their healing was complete without the necessity of skin grafting.

One patient proved to be unco-operative and was released from our service. We do not know how he fared with regard to his injury.

The comfort of those patients who were under our care, was very evident since they were many times surrounded by other patients who were being treated by other attending men who used various other methods. After the first week all of our patients were well enough to become ambulatory while the other patients, not under our therapy, still remained in bed. Several of these have developed extensive keloids.

Since these findings are to be considered preliminary in nature, we do not advocate this method as a proved method. We describe these interesting findings with the hope that other surgical colleagues will try this procedure on their own series of cases and formulate their own opinions as to the efficacy of our modification for the treatment of burns.

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COMBINATION OF NAIL AND SCREW FOR THE FIXATION OF FRACTURES OF THE NECK OF THE FEMUR

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THE writer started the operative treatment of hip fractures in 1919 by using bone transplants. Of the four patients operated upon, two had excellent results; in the other two the grafts were absorbed and broken before union took place. It is still probable that the bone graft might be used advantageously in association with some metal fixative in the subcapital fracture when it is believed that the circulation of the head has been materially decreased or entirely destroyed.

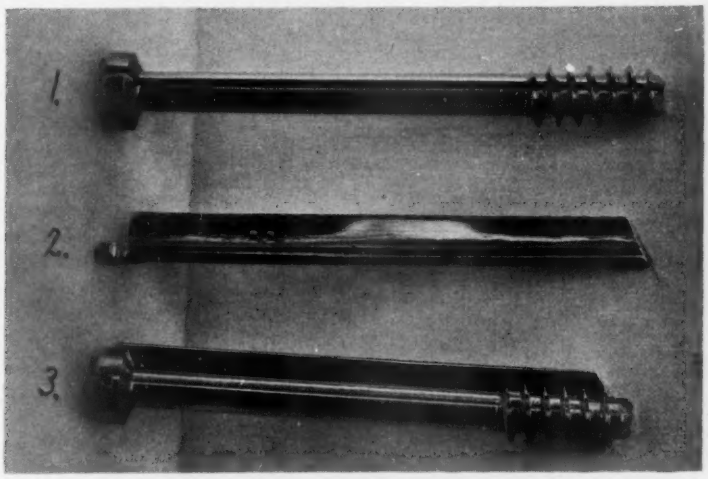

FIG. 1. The combined screw and nail (keyed screw): 1, The screw, threaded only at the end, showing slot from end to end to receive the key; 2, the key, which is to be driven in after the screw is inserted; 3, screw containing the key.

In fractures of the femoral neck certain mechanical requisites should not be overlooked. The great advantage to the patient in the use of the metal fixative which replaces so successfully the older traction and plaster of paris methods is apparent to anyone coming in contact with many of these cases. Most of the patients are in the later years of life and consequently are more subject to the effects of shock. They are not satisfactory candidates for long periods of bed confinement and convalesce more satisfactorily if they can turn over, sit up frequently, or be out of bed, as the case may be, which is possible if a metal pin has been used.

The operative procedure should be the most simple, of the shortest possible duration, and the least likely to be complicated by infection. With these things in mind we have devised a method which we think is the simplest and least shocking to the patient and perhaps one of the best methods of holding the fragments in position for healing. If a mechanic were asked to repair a table leg and he had only screws and nails at hand, we believe he would prefer the screws. The screw offers more security than the nail in holding parts together. Also no hammering is necessary. We have never observed any necrosis

around a screw and have used different metals. We have seen aseptic necrosis of the femoral neck in several cases but in no instance did it appear that the metal was a cause.

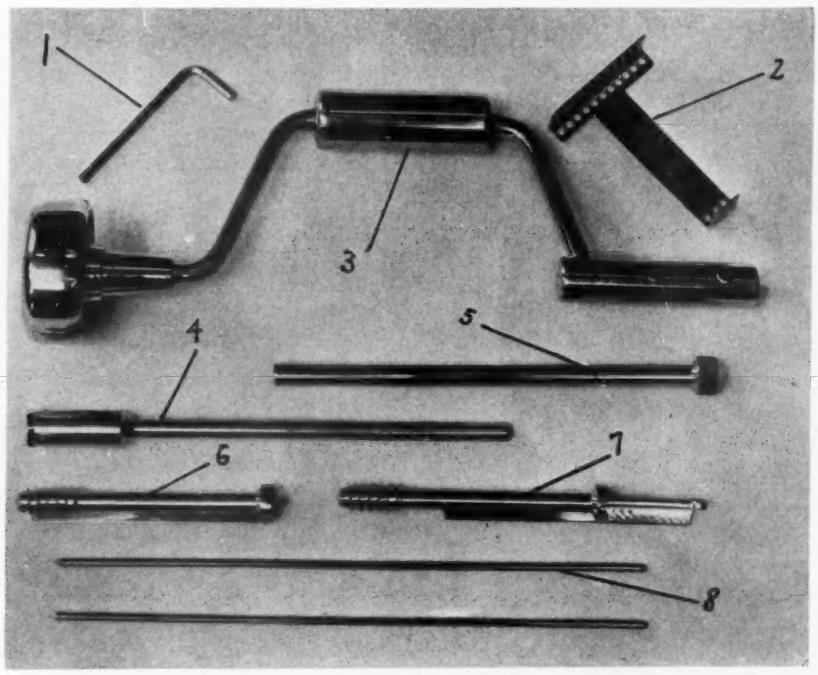

FIG. 2. Insertion set: 1, Allen wrench for brace; 2, director for guide-wire, if open operation is used, without leg-holder or fluoroscope; 3, brace for inserting guide-wire and screw-driver. Note shoulder on chuck for use of mallet if needed; 4, screw-driver specially made for insertion and extraction of screw; 5, key inserter; 6, screw with key in position; 7, screw with key inserted partially; 8, guide wires.

Because of the frequent occurrence of aseptic necrosis in the neck of the bone, we believe the screw should be firmly held in the head by deep threads. It should penetrate the head as far as possible even to engaging the cortex but, of course, it should not penetrate the joint. The threads on the screw are valuable only for their grasp of the head and they should not extend below the line of fracture. A screw constructed in this manner, with a smooth shaft, will not alter its position and will not work out as nails sometimes do, because they have nothing but friction to hold them in position. With this type of screw there is nothing to prevent constant apposition of the fracture surfaces should necrosis occur. If threads are continued down the shaft of the screw and necrosis occurs, the fragments, being held apart by the threads on the shaft of the screw, will retain their apposition with great difficulty or not at all. A nail, or in fact any fixative that is not fixed to the head, may become loose and alter its position or even drop out. Also if it is fixed at the cortex of the shaft of the bone, it would be forced into the acetabulum or pelvis, should necrosis of the neck take place. Even the nail which is too tightly wedged into the cortex of the shaft of the bone may work gradually through the head and pelvis if necrosis occurs.

A screw, being round, does not prevent rotation of the head of the bone. To overcome this, two screws—sometimes parallel have been used. This, of course, requires twice as much work. To obviate the necessity of using two screws we devised the combination of nail and screw. The flanged nail has the advantage of preventing rota-

tion of the head. Our screw has a channel from end to end so that it readily follows a guide-wire. It also has a slot from end to end for the reception of a key which is the same length as the screw and is very easily inserted. The key is thicker on the inner border and is made to fit the guide-wire channel. It is flat and when inserted projects through the slot from end to end of the screw. It is driven in after the screw is inserted. The screw provides compression of the fragments and the key becomes a flange which prevents its change of position and also prevents rotation of the head. It may be inserted by any method of choice, large incision or small puncture.

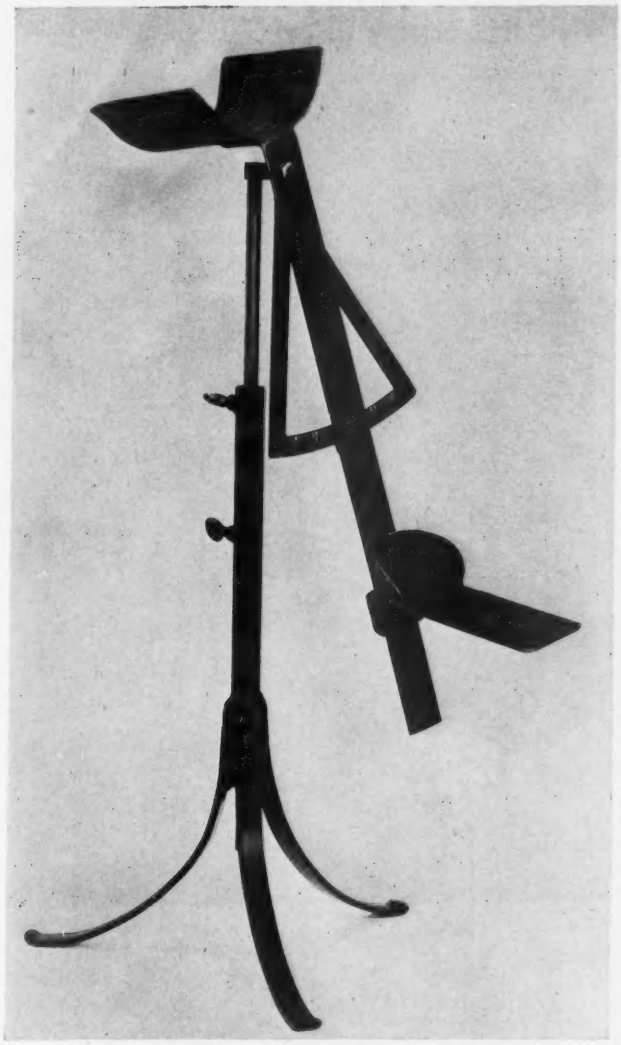

Fig. 3. The leg-holder consists of the standard; the holder for thigh at knee and the movable foot-holder; it is adjustable to either leg. A scale is marked from 0 to 35 degrees of a quadrant for abducting the leg and holding it at a specified angle during the operation.

To determine the length of screw required, measure the distance from the outer cortex of the shaft to the outer cortex of the head, using the roentgenogram of the opposite hip, or of the affected one after reduction. A screw four-fifths of that length will not perforate the joint but may be an eighth to a quarter of an inch too short. Should the screw be too long or too short it is very easily removed so

that one of the desired length may be substituted. The inner end of the screw should incorporate as much of the head as possible, of the fluoroscope in the operative fixation of hip fractures. We have used it so many times that we would consider hip-nailing

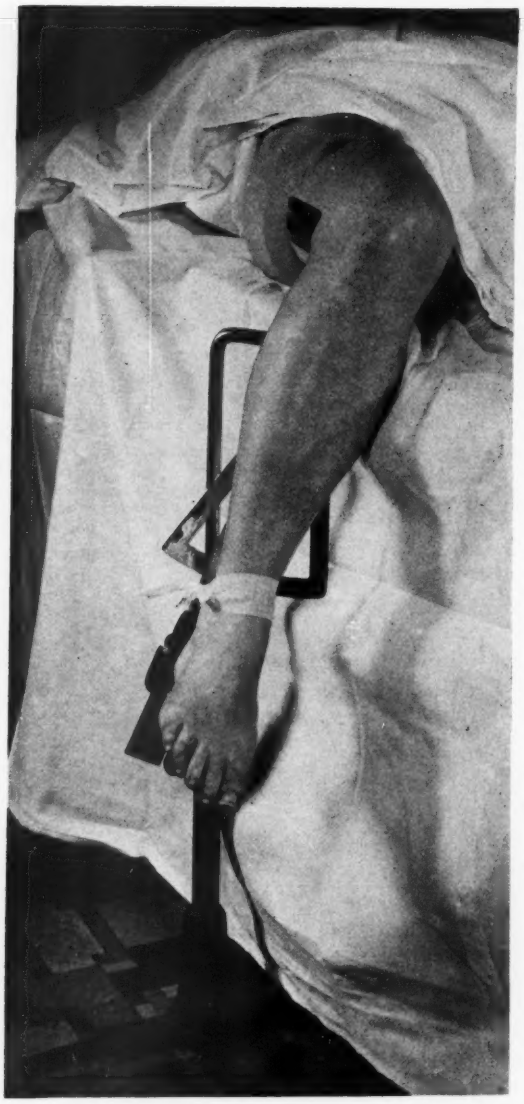

FIG. 4. The patient is on the *x*-ray table with leg abducted, after reduction, and ready for placing of pencil lines on the skin by use of the fluoroscope and heavy wire.

especially in the subcapital type of fracture. One is indeed fortunate when the fixative penetrates so deeply that it almost enters the joint, because the center of the head is softer than the cortex and not as capable of firmly holding the screw when it has to combat the sheering forces of the muscles.

Something should be said also about the advantages to be obtained from the use difficult without its aid. One must have capable, co-operative assistants to accomplish satisfactory results. The average *x*-ray table is suitable. Sufficient space must be available in the room for the sterile team to function safely. The patient is given a spinal anesthetic. We use 50 mg. of novocain and 1 cc. of nupercain solution. The fracture is reduced by the Leadbetter procedure, and the affected hip is placed

in the center of the table (laterally). The leg and foot are brought over the side of the table at a right angle with the thigh, against the trochanter and iliac crest. If the lateral roentgenogram is satisfactory, the trochanter, neck, and head, will be

Fig. 5. Screw being inserted over guide-wire and visualized on fluoroscope. The fluoroscope is covered underneath by sterile towels. Note the pencil lines on skin, and that the screw has entered at the point where the lines cross.

and then placed in a leg-holder which holds the leg at 18 degrees abduction. This in turn rotates the head, neck, and trochanter into a horizontal plane, the value of which will be discussed later. The fluoroscope will demonstrate the postero-anterior projection of the fracture (since the undertable tube is being used) and if it is satisfactory, a lateral roentgenogram should then be taken, which will be accomplished best by using a portable *x*-ray machine directed under the elevated and vertically flexed opposite thigh, the casette being held superimposed upon it. Should the trochanter require shifting to place it directly in line with the head, note that five degrees' movement of the foot and leg in the leg-holder will shift the trochanter about ½ cm. either way; but we have found that placing it at 18 degrees is correct in most instances.

Reduction and position being found satisfactory, the room is darkened and the fluoroscope is again lowered to the level of the patient. The roentgenologist or technician visualizes the head, neck and tro-

chanter on the screen, closing the shutter to a beam as narrow as possible. A heavy wire about ten inches long is placed on the patient and under the screen, and directed by the use of the fluoroscope to a position in line with that to which the guide wire and screw will be inserted later. The lights are now turned on. After ascertaining that the wire has not moved out of place, draw a line with a skin pencil from it vertically down the outer side of the thigh, and cross this line at right angles with another pencil line, drawn on the skin, directly lateral to the center of the femoral shaft, bisecting it horizontally. The point where these lines cross indicates where the puncture should be made in the skin to admit the guide-wire and later the screw and key. The heavy wire, being of no further use, is removed from the field and must not be confused with the guide-wire.

Fig. 6.

Fig. 7.

Fig. 6. Lateral view of fracture of the neck. The guide-wire has been inserted, having been held horizontally, with leg in holder at 18 degrees abduction at time of insertion.

Fig. 7. Lateral view of keyed screw inserted over a guide-wire.

The surgeon scrubs and the nurses prepare the patient in the usual way for a major surgical procedure. The screen is covered on its undersurface with a sterile towel attached by adhesive strips to its edges, leaving the upper surface uncovered. The usual draping and sterile operating room methods supervene. A three-fourths inch incision parallel with the long axis of the thigh is made in the skin through the point where the pencil lines bisect and horizontal to the center of the shaft of the femur. The scalpel is pushed to the

bone in the horizontal direction and the tissues are spread apart with a hemostat. The guide-wire is inserted through the incision, the room is darkened, and with the aid of the fluoroscope the wire is correctly placed against the center of the cortex and at the desired angle to enter the neck and head. The operator holds the wire in a horizontal position. He inserts it slowly, being directed by the fluoroscope. He sees it pass through the cortex and along the neck to the head. Rarely is a wire found to be in faulty position on its first insertion if it is held horizontally. The lights are now turned on. Only a lateral roentgenogram is needed for confirmation. It is taken in the following manner: The casette is placed in a sterile pillow slip and held against the wire and the iliac crest by the sterile nurse while being exposed to the portable *x*-ray machine as already described. If the roentgenogram is satisfactory, the screw and driver are now assembled and the screw is placed on the guide-wire and driven into place by a special screwdriver, which is hollow and follows the screw over the wire. Near the completion of this step, the lights are turned out and the fluoroscope is used to see that the length of the screw is right, and that it is turned tightly but not too tightly, preserving the grip on the threads in the head. The lights are turned on again. The key is inserted into the slot and tapped gently into position. At no time during the operation does the gloved

Fig. 8. Anteroposterior view of keyed screw in a case in which fracture occurred close to the trochanter. It is unnecessary for the screw to be sunk as deeply into the head as in subcapital fractures.

hand touch any part of the guide-wire, screw, key, or wound. Two silk skin sutures complete the operation.

We have performed fifty-four of these puncture operations for the fixation of hip fractures. We are finding this method more and more simple and eminently suitable for the aged because of the slight injury to the patient.

We believe the *x*-rays are not dangerous to anyone in using this method, as the periods of use are very brief and the operator's hands are well out of the field of danger.

While some fear that sterilization of the field is less certain because of doing the work in an *x*-ray room, we have not found that to be the case. We believe that a well trained team can work just as safely and successfully in an *x*-ray room as in an operating room, especially if the small skin-puncture method is used. The great decrease in the number of roentgenograms necessary and the shortening of the time required to perform the operation are worth considering.

Fig. 9. Subcapital fracture with extensive absorption of the neck. The screw was sunk as deeply as possible into the head. Note how the head of the screw projects beyond the shaft, without much probability of a change of position or loss of grip on the head, while still holding the fracture surfaces in fair position nine months after insertion.

SUMMARY

1. A screw, consisting of a combination of screw and nail, for the fixation of hip fractures, is described.

2. A leg-holder, which maintains a constant position of the head, neck, and trochanter during operation, and is capable of rotating them to a horizontal plane, simplifies the insertion of any fixative, whether it be nail, bolt or screw.

3. A method of inserting a screw through a small skin puncture, obviating the need for an extensive incision, is described.

4. A method of using the fluoroscope so that a guide-wire, nail or screw, may be inserted under full vision, without risk to the operator, is shown.

PARENTERAL FLUID ADMINISTRATION BENEATH THE FASCIA LATA*

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THE importance of meeting adequate fluid and electrolyte requirements in the sick surgical patient cannot be stressed too strongly. A marked decrease in morbidity and mortality has been evident in those patients whose requirements are competently and carefully supplied day by day. This replacement of fluids assumes its greatest consequence in the patient unable to take fluids by mouth.

The giving of fluids and electrolytes by parenteral means has been employed for many years. Originally, they were given for the most part by proctoclysis. However, this method has fallen into disrepute to some extent in late years for several reasons. Among these may be mentioned first, technical difficulties in administration; second, inability of many patients to retain fluids rectally; third, variations in absorption among different patients; and fourth, doubtful accuracy as to the exact fluid intake. Thus, the utilization by the surgeon of more precise methods, such as intravenous and subcutaneous infusions, has largely supplanted rectal fluid administration.

Recently, Tocantins[1] has described a method of infusion into the sternal bone marrow and has devised a needle for administration. This shows great promise as an adjunct in regulating parenteral fluid intake.

Infusions by the intravenous and subcutaneous routes, however, are still the methods of choice of most surgeons at the present time. Unquestionably, hypertonic solutions and whole blood, where indicated, should be given by the intravenous route. However, there is a widespread difference of opinion as to the relative merits of hypodermoclyses and of intravenous infusions in giving isotonic or near isotonic fluids.

Probably the greatest source of dispute between the adherents of the two methods rests on the safety factor of the hypodermoclysis as compared to the ease of administration and lack of pain of the venoclysis. That there is definite harm in indiscriminate use of intravenous infusions cannot be denied. Orr[2] summarizes these dangers as, first, immediate reactions; second, overburdening of the circulatory system by rapid increase in blood volume; third, thrombosis and concomitant embolus formation at the site of injection; fourth, the danger of dehydration because of the use of hypertonic solutions; and fifth, the production of general edema. He has discontinued the use of continuous intravenous infusions because of the danger of local venous thrombosis and embolism and reports one fatality following excessive quantity of fluid by vein to an anemic patient with damaged heart muscle.

Clark[3] stresses the dangers of acute cardiac dilatation. Hirshfeld, Hyman and Wanger[4] call attention to the possibility of so-called "speed shock" when venoclysis is given too rapidly. Further dangers and fatalities have been reported by Orator

* This work was done on the Surgical Service of Dr. R. K. Finley at the Miami Valley Hospital, Dayton, Ohio.

and Schleusing,[5] Tomarkind and Strauss,[6] Rumold,[7] Friedrich and Buchaly,[8] and Cutting, Landis and Larson.[9]

On the other hand, many objections have been raised to the administration of subcutaneous infusions. It is generally admitted that this method is more physiological, in that the fluid given is absorbed by the circulation as needed rather than introduced indiscriminately at varying rates of speed, usually left up to the discretion of the nurse. However, the disadvantages of the clysis usually enumerated are first, severe pain and discomfort at the site of injection; second, immobilization of a postoperative patient for several hours at a time when frequent turning is greatly desired; third, local pressure ischemia at the site of injection due to swelling and distention; fourth, frequent slow absorption; and fifth, the danger of infection in the subcutaneous tissues. Morrison[10] points out the danger of cyanosis and decreased vital capacity in subpectoral clysis, while Orr[11] and Tenopyr and Shapiroff[12] mention the possibility of gas bacillus infection.

SUB FASCIA LATA HYPODERMOCLYSIS

In an effort to obviate the disadvantages of hypodermoclysis and still make use of the many desirable factors this method offers, we began the study of various methods of subcutaneous fluid administration. It was soon obvious that regardless of the site, whether on the chest, abdomen, back or thighs, the introduction of fluids immediately under the skin caused a rather violent disruption of the subcutaneous tissue. The result was that unless the patient was decidedly dehydrated, only about 50 to 100 cc. of fluid could be delivered per hour without marked discomfort.

It has been shown (Van Hook[13]) that there is no pain experienced in giving subcutaneous infusions if the fluid is not given at a speed greater than the ability of the tissue to absorb it. Furthermore, it is obvious that the greater the absorption area, the faster a solution will be absorbed. It occurred to us that there was a large potential space for absorption immediately beneath the broad layer of fascia on the lateral aspects of the thigh. This fascial band, the fascia lata, dissects easily from the underlying muscles, as is often demonstrated surgically when fascial transplants are taken. The fascia lata has extensive attachments above to the pubic bones, inguinal ligament, iliac crest, sacrum and coccyx and below to all the prominent points around the knee joint. Taking all these factors into consideration, we felt justified in giving sub fascia lata hypodermoclysis a careful trial. The results were gratifying.

We have been unable to find any description of this exact method in the literature, and believe that it merits preëminent consideration when parenteral isotonic or near isotonic solutions are required. The technic is simple. After the skin on the lateral aspect of the thigh is prepared with a good skin antiseptic, the standard eighteen gauge hypodermoclysis needle is inserted at about a forty-five degree angle to the skin. The point of preference is at the junction of the lower and middle third, lateral surface, and equidistant between the anterior and posterior aspects of the thigh. The needle is inserted to the fascia lata, where a sensation of "give" is felt as the point passes through the fascia. The point is allowed to remain at this depth although it may have to be altered slightly until the best rate of flow of the solution is obtained. The solution is suspended approximately three feet above the legs and allowed to run as rapidly as possible. Only rarely is it necessary to check the rate of flow. The needles are not taped to the skin, since they are held in place quite firmly by the fascia. There is no danger of breakage of the needle, if it is not taped, since the fascia acts as the only fixed point and the needle is permitted to swing slightly if necessary. A pillow beneath the knees relaxes the fascia and facilitates insertion of the needles. In unconscious patients,

the knees are lightly tied together with gauze bandage.

ANALYSIS OF RESULTS OBTAINED IN SUB FASCIA LATA CLYSIS

Careful studies were carried out on 261 consecutive sub fascia lata hypodermoclyses started in every instance by one of us. A complete analysis was not carried out on approximately 500 additional cases started by nurses taught this method, although the results closely checked with those started by us. Sixty three of these 261 cases were of physiological saline solution and 198 were of 5 per cent dextrose in saline solution. For uniformity, every clysis given consisted of one liter (1,000 cc.) of fluid. The total number of patients receiving these hypodermoclyses was 112, many patients receiving several clyses. The greatest number given to any one patient was nineteen. This patient, operated upon for ruptured peptic ulcer, suffered from severe myocardial damage, and fluids given intravenously were restricted to blood transfusions.

Table I

AVERAGE TIME FOR COMPLETE ABSORPTION OF 1,000 CC. OF FLUID GIVEN BENEATH THE FASCIA LATA IN 261 CASES

	Cases	Absorbtion in Minutes
Physiological saline	63	53
Five per cent dextrose in saline	198	57
Combined	261	56

The average length of time for complete absorption of 1,000 cc. of both types of fluid was fifty-six minutes. The saline solution was absorbed at a slightly more rapid rate of speed than was the dextrose, the average being fifty-three minutes as compared to fifty-seven minutes for 5 per cent dextrose, which is slightly hypertonic. (Table I.) It took less than twenty minutes for absorption in thirteen cases (5 per cent), between twenty and forty minutes for seventy-four cases (28 per cent), and between forty and sixty minutes for 116 cases (44 per cent), making a total of 203 cases (77 per cent) absorbed in less than one hour. Only thirty four cases (13 per cent) took longer than eighty minutes while twenty-four (9 per cent) took between sixty and eighty minutes. (Table II.)

Table II

TIME TAKEN FOR ABSORPTION OF 1,000 CC. OF FLUID GIVEN BENEATH THE FASCIA LATA IN 261 CONSECUTIVE CASES*

Time Consumed in Minutes	Cases	Per Cent
0– 20	13	5
20– 40	74	28
40– 60	116	44
60– 80	24	9
80–100	13	5
Over 100	21	8
Total	261	99

* Note that 203 cases (77 per cent) were absorbed in less than one hour, while 240 cases (92 per cent) took less than 100 minutes.

For comparison, the time for absorption of 1,000 cc. of fluid by hypodermoclysis given on the medial aspect of the thigh was computed. In thirty-three consecutive cases, the average length of time was 167 minutes.

Table III

AVERAGE RATE OF ABSORPTION FOR SUB FASCIA INFUSION, AS RELATED TO AGE OF PATIENT. THE BEST RESULTS WERE OBTAINED OVER THE AGE OF FIFTY, PROBABLY DUE TO GREATER RELAXATION OF THE FASCIA

Age in Years	Absorption in Minutes
0–30	59
30–50	65
50–70	57
Over 70	41

Upon dividing the patients into age groups, it was soon evident that the older the patient, the more quickly the fluid was absorbed. (Table III.) The average length of time for absorption in patients above the age of seventy was only forty-one minutes as contrasted to an average time interval of sixty-five minutes between the ages of thirty to fifty. That this is

not entirely due to greater dehydration in the older group was clearly shown when all cases were compared on the basis of the urinary output during the previous twenty-four hours. While urinary output should not be used alone as a basis for hydration since it does not take into consideration factors such as fever and increased metabolism, yet it does provide a simple, fairly accurate gauge for comparative studies in a large series of cases.

Using urinary output as a rough control for the state of hydration, it was found that in those cases in which the urinary output was below 500 cc. in the previous twenty-four hours, the rate of absorption was forty-one minutes. However, in those patients with an output of between 1,000 and 1,500 cc., the rate of absorption was only slightly increased, averaging forty-five minutes. The average time for absorption was longest in the group whose urinary output varied between 500 to 1,000 cc.

In comparing the time for absorption as related to the state of hydration, in patients of various age groups, it was found that in the patients above the age of seventy, whose rate of absorption was only forty-one minutes (Table III) the average urinary output was 1,023 cc. during the previous twenty-four hours. Thus the difference in absorption which was evident in the various age groups is due to some factor other than dehydration, and most probably due to greater relaxation of the fascial structures in the older patients with concomitant increased area for absorption.

No significant differences in absorption rates were seen according to sex or to weight.

While it is true that there is a great variation in the pain threshold in different patients, yet the pain experienced was evaluated as accurately as possible, since pain has always been a major objection to administering subcutaneous infusions. A total of only forty-four patients (16 per cent) experienced pain in any degree. Of these, thirty-seven are graded as moderate or mild in character while only seven complained of severe pain. As was expected, fewer patients (12 per cent) complained of pain following saline infusions than following 5 per cent dextrose infusions (19 per cent). Many of the patients suffered discomfort in only one leg. (Table IV.)

TABLE IV

PAIN AND SWELLING OBSERVED IN 261 CASES OF SUB FASCIA LATA INFUSION. MANY PATIENTS COMPLAINED OF DISCOMFORT IN ONLY ONE LEG

	Mild	Moderate	Severe	Total Cases	Per Cent
Pain	20	17	7	44	16
Distention	36	20	2	58	22

There appeared to be a slight but definite relationship between pain and speed of absorption. The average time consumed in absorption of the infusions causing pain or discomfort was sixty-two minutes for the glucose group and fifty-five minutes for the saline group, in both cases above the average for the group as a whole.

Swelling of one or both legs, so commonly seen in the ordinary hypodermoclysis, was observed in only fifty-eight patients (22 per cent). The swelling again was more commonly found when dextrose was given. In grading swelling as mild, moderate or severe, it was found that thirty-six patients had only very slight swelling, twenty had moderate swelling, while in only two cases was marked swelling noted. (Table IV.)

As might be expected, there was a definite relationship between pain and swelling. Thus of the forty-four patients complaining of pain, thirty-four also suffered from visible distention of the tissues.

There was only one complication observed. This patient developed an extensive infection on the lateral aspect of the leg. He had received approximately twenty hypodermoclyses, many of which were started subcutaneously by the nurses. Abscesses developed along the leg but at

operation these were found to be confined entirely to the subcutaneous tissue superficial to the fascia. This infection was evidently introduced into the subcutaneous tissue and found a ready bed in the ischemic tissue present secondary to the marked swelling so often seen in the ordinary type of hypodermoclysis.

COMMENT

While it was believed that the fluid introduced beneath the fascia was absorbed rapidly and did not pool beneath the fascial sheath, since there was so little evidence of swelling, nevertheless comparative studies were made on the rate of absorption between intravenous and sub fascial infusions. These were conducted by giving 1,000 cc. of 5 per cent dextrose in physiological saline, to which had been added 1 cc. of phenolsulphophthalein dye, both intravenously and by sub fascia lata infusion to the same patient on different days. The tests were conducted both on patients in good health and on patients with known kidney damage. Usually the tests were run on the tenth to twelfth postoperative day with the patient in condition to be discharged from the hospital, and care was taken that the state of hydration was essentially equal on the days the tests were conducted. The rate of flow was adjusted so that both types of infusions were delivered in one hour. A retention catheter was inserted and the bladder drained at the termination of the administration of fluid. The bladder was irrigated in order to be certain that all the dye excreted would be obtained. Specimens were collected at six one-half hour periods.

It is valid to assume that the amount of dye returned in the urine is representative of a proportional amount of fluid absorbed from beneath the fascia, since in a patient in good fluid balance, the urinary excretion will be approximately the same from day to day under similar conditions. Since the dye is removed from the blood stream at a constant speed by the kidneys, it follows that the rate of absorption is the only remaining variable. In this manner, the rate of absorption of a sub fascia lata

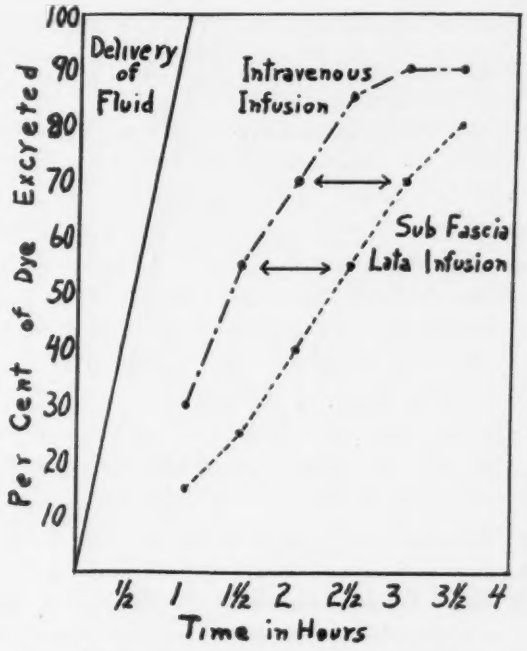

Fig. 1. Excretion of phenolsulfonphthalein dye in the urine following infusions of 1,000 cc. of saline containing the dye by intravenous and subfascia route. Each infusion was delivered in one hour to the same healthy, well hydrated patient on consecutive days. Note that the absorption is at a constant rate with a lag of approximately one hour when given beneath the fascia as compared to the intravenous route. This represents practically immediate absorption from the subfascia space.

infusion can be estimated by comparing the phenolsulfonphthalein excretion with that of an intravenous infusion which may be considered to have immediate absorption.

On comparing the rate of excretion of the dye, it was found that there was only a difference of excretion in the two types of infusions of about one hour. (Fig. 1.) This difference proved to be consistent in those patients with myocardial and kidney damage as well as those with good renal function and cardiac reserve. Since the sub fascial infusions were adjusted to deliver the solution to the patient in just one hour, which was the same time taken for delivery of the intravenous fluid, it

appears evident that there must be almost immediate absorption of the fluid.

There are undoubtedly certain patients who should never receive sub fascial infusions, such as those with generalized edema or patients in shock. In general, the same contraindications exist to giving fluid beneath the fascia lata as beneath the skin. In infants, a 3 per cent solution of dextrose should be given rather than the 5 per cent. We have given as high as 200 cc. beneath the fascia in a six-week old dehydrated infant, weighing less than seven pounds, in forty-five minutes, without visible swelling or noticeable subjective evidence of discomfort.

While the investigative work on sub fascia infusion has been done with physiological saline and 5 per cent dextrose in saline, there appears to be no reason why other solutions cannot be delivered to a patient by this method. Cooper[14] has shown, in one patient suffering from cirrhosis of the liver, that ascitic fluid is absorbed rapidly from beneath the fascia. This absorption of ascitic fluid, rich in proteins, maintained the blood chemistry as shown by repeated blood albumin and globulin determinations, and also maintained the improved clinical condition of the same patient as demonstrated by lack of ankle edema.

Attention should be called to several additional factors in the administration of sub fascia lata hypodermoclysis. After learning the technic, these infusions can be left entirely in the hands of the nurse. Also, since there is no necessity for constant supervision, because of the diminished pain and distention as compared to ordinary hypodermoclysis, there is a definite saving of nursing time and care.

The sub fascia lata infusion is far safer than the ordinary type of hypodermoclysis. There are no large vessels on the lateral aspect of the leg, no embarrassment to respiration or danger to axillary vessels as is true with hypodermoclysis on the chest, and no danger of inadvertently introducing the solution into the knee joint. There is also less danger of secondary contamination in the incontinent patient. The patient, in addition, can ordinarily be turned from side to side within an hour after the infusion has been started, thus eliminating long periods of immobilization and subsequent increased hazards of pulmonary complications. There is no danger of breaking a needle if the needles are not taped to the skin.

Finally, because of the minimal amount of discomfort and swelling, there is no need to give more than one liter at a time. The infusion may be repeated several times daily if necessary to maintain proper fluid and electrolyte balance, with perfect safety and minimal discomfort, thus decreasing the potential and real dangers of repeated intravenous infusions. Intravenous fluid may be restricted to hypertonic solutions or blood transfusions when indicated.

CONCLUSION

An improved method of administration of parenteral fluids beneath the fascia lata has been described. In 261 consecutive sub fascial infusions of 1,000 c.c. of saline or 5 per cent dextrose by this method, the average time for delivery of the solution was fifty-six minutes. In thirty-three patients the average time for absorption of the same amount of fluid by hypodermoclysis was 167 minutes. The solution appears to be absorbed rapidly, as shown by excretion of phenolsulfonphthalein dye in the urine. This absorption probably takes place in the extensive loose areolar space and capillary and lymphatic bed just beneath the fascia lata. There is more rapid absorption in elderly patients, probably because of more lax structures. The rate of absorption is not greatly influenced by the state of dehydration.

There is minimal swelling and pain in sub fascia lata infusion. Because of the decreased discomfort, increased rate of absorption, and unquestionable safety of the method, fluid and electrolyte needs can be replenished several times daily

in this way and intravenous solutions restricted, for the most part, to transfusions and hypertonic fluids. The sick surgical patient may be moved in bed frequently, without long periods of immobilization. Finally, the technic of insertion on the lateral thigh is simple and because of the rapidity of absorption, the entire procedure can be left safely in the hands of the nursing staff with elimination of a large amount of nursing time and care.

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PERINEORRHAPHY POSTPARTUM VERSUS PERINEAL REPAIR

ORIGINAL TECHNIC

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A PREPONDERANT majority of women sustain an assault on their perineum and anterior vaginal wall during the delivery of a child; but the severest assault they sustain during the first full term or near term delivery. Tears are as a rule visible; but the invisible ones are just as fraught with serious consequences as the frankly visible ones. The postanococcygeal, the anopostanal, the anal, the anoperineal and perineovaginal sections of the pelvic floor are stretched consecutively during the end of the first stage of labor and the beginning of the second stage, to a point where the tissues snap in the most vulnerable portion; and that is, as a rule, the perineovaginal or vaginal portion. This causes the visible tears. The first sign of such occurrence is bleeding from the vagina when the head is bulging the perineum. An examination of the vagina between pains will show a mucous or submucous tear. This bleeding is often referred to as the show, but this is of a different nature than the show seen at the onset of labor. We have then to distinguish between uterine show and vaginal show.

The most dependent portion of the pelvic floor is the anal region, but this is sufficiently dilatable to preclude a tear here at this stage of labor; and this dilatability is in direct relation to the mobility of the coccyx. The most vulnerable part is the perineovaginal. Owing to the influence of the anal dilatability and its own moderate resiliance it will often not sustain a frank tear or, depending upon other circumstances, will escape a tear completely. Dr. Herbert M. Little[1] mentions "the possibility of subcutaneous rupture of the muscles" of the perineum. The fascia in invisible tears is torn, attenuated or separated from its attachment or all these injuries combined may be present; and the angle or ellipsoid formed by the levators at this lower point is now deepened and widened or rounded; thus permitting, subsequently, a rectocele formation. Such blind tears as well as the frank ones, if uncorrected or insufficiently corrected, will, in addition to forming a rectocele predispose to cystocele development, and depending upon the extent of the injury, will also pave the way for a prolapsus uteri. Retroversion or retroflexion, independent of prolapsus, is as a rule an anteceding condition. The relaxed and sagging state of the vagina or the absence of tonicity of the same, will not only prevent a cervical tear from healing by first intention but will permit eversion of the lips with all the baneful effects. The blind tears are always left alone. A mucous tear is sometimes united and if the sutures are inserted deeply enough will mitigate the injury.

Frank tears are as a rule repaired. Episiotomies are always repaired. I employ the word "repaired" advisedly because that is just what should not be done. A perineorrhaphy is indicated.

Repairs of the perineum are usually done when the obstetrician believes that he is doing a perineorrhaphy, and this because he inserts the sutures deeply, intending to include the levators, when he is only embracing the tumified and broken fascia and more or less of the anterior edge or

aspect of the levators. As a matter of fact the levators, in reaction to the push and tension exerted on them by the head and

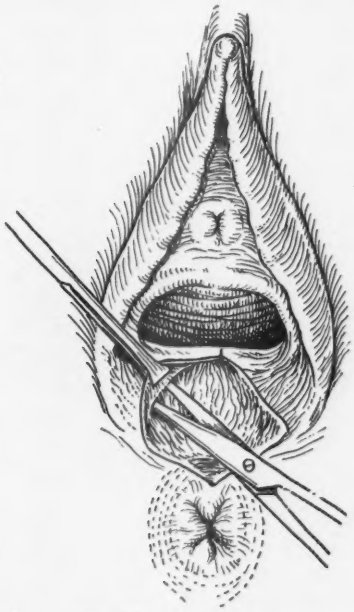

Fig. 1. Grabbing edge of mucous membrane and undermining it with blunt pointed scissors in an advancing opening and closing manner. In order to prevent the mucosa from tearing, the points of pressure of the scissors are gently directed toward the fascia. This maneuver is continued until the levators are exposed in depth and in height. The short longitudinal line in the center of the upper edge of the tear is intended to suggest its enlargement after undermining the mucous membrane and cutting it in the midline to facilitate the separation of upper ends of the levators. Occasionally, we encounter a mucous membrane that is friable. Regardless of such friability, the object is to expose and unite the levators; nature takes care of the breaks or missing parts of such mucosa.

shoulders will, on release of such pressure, suddenly recede one-fourth inch or more from their normal position; or they will be pushed forward and laterally into the blind semi-circular concavities; they can be normally outlined with the tip of the finger. (The delimitations of these concavities are, anteriorly, the hymen or its base and posteriorly, the anterior edge of the levator ani; above the angle formed by the union of the levator with the pubes; externally by the pubic ramus; the lower boundary is formed at the point of branch-

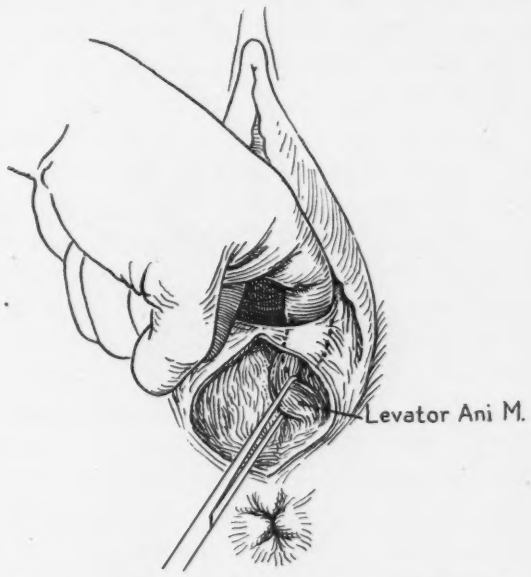

Fig. 2. The complete depth of the left levator ani muscle caught within the grasp of the tenaculum forceps with the aid of the finger pushing the levator forward. The same thing is done to the right levator.

ing of the levator surrounding the anal sphincters; internally it is bounded by the loose vaginal mucosa.) When both levators are forced into these blind pouches, the inflated rectum usually fills the space bebetween them. These reactions are implemented by the extent of the tear. With a "repair," the widened or squared or semicirculared lower angle of the levators remains,usually, sufficiently ample to permit the formation of a rectocele. A cystocele or prolapse or relaxation of the anterior vaginal wall of some degree invariably follows unless it is supported by a high perineorrhaphy. If injury is slight, "repair" is often sufficient; but the tear may be both, partly visible and partly invisible and the extent of the injury is then an unknown quantity.

The difficulties of doing a perineorrhaphy are almost insurmountable in a delivery room equipped for deliveries and at best for perineal repairs. In an operating room, in doing a perineorrhaphy, we have the assistance of two interns, a scrub nurse

and a circulating nurse. In a delivery room we get, as a rule, one assistant or a scrub nurse or neither. Under the latter condition the obstetrician has to do his own draping of the patient and his own needle threading, etc. In view of these obstacles and in the presence of receded levators and often of an impacted and depressed tear which takes place even when an episiotomy has been done, a repair is really all that can be done. The results are almost always good but not better or best. In recent years episiotomies are done in primiparas; but even if they extend into a tear, the technical difficulties for doing a perineorrhaphy remain. A high perineorrhaphy is the only way to prevent cystoceles and cervico-uterine complications.

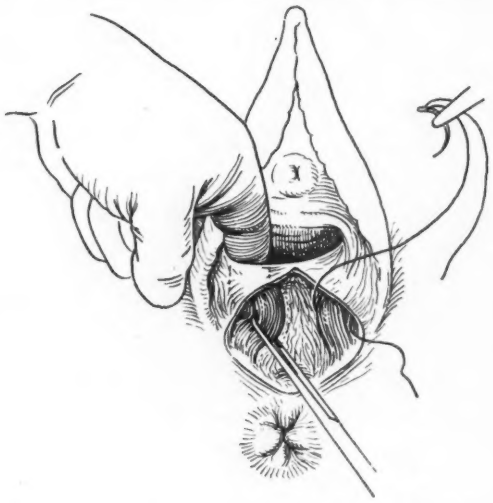

Fig. 3. Showing suture passed through left levator ready to include the right one. The right levator may be pulled forward with the tenaculum or pushed forward with index finger in vagina.

I have devised a technic in which a perineorrhaphy can be done without assistance if necessary. The crux in its execution is, like in any perineorrhaphy, the isolation and union of the levators to as nearly an antegravid state as possible.

The vaginal mucosa, by blunt dissection, is peeled off its fascial attachment and continued to the posterior aspect of the levators and up to near their pubic insertion. The edge of the mucosa is grabbed, but not clamped, with an Allis forceps, preferably one with its teeth filed off. A blunt pointed straight scissors is pushed under the forceps (Fig. 1) and hugging the undersurface of the mucosa in an opening and closing manner dissection is carried to the desired depth. These steps are successively repeated until the fascia and levators are freed. Should there be a tendency for the mucosa to tear, the tip of the finger can often be used to supplement or supersede the scissors in the process of blunt dissection.

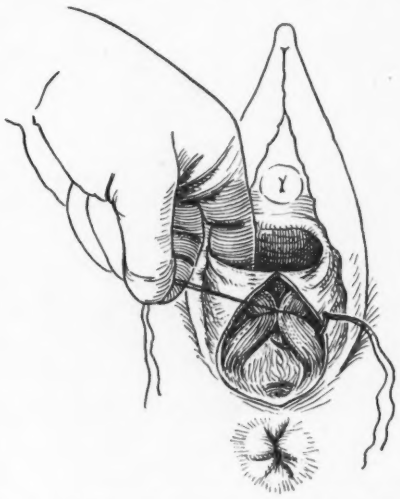

Fig. 4. The first suture tied and its ends used instead of tenaculae to make traction as they are held between the thumb and second finger. This traction is supplemented by the index finger in the vagina pushing the levator forward while the rest of the sutures are inserted. The finger or fingers are changed from right side to left and from left side to right as is called for by the technic of the operation.

The fascia layers are closed in the usual manner excepting that a few strands of the levators are included in each suture. In closing the skin a few small facets of the fascia are included for the same reason, and that is to prevent occult spaces. Several times I have seen the skin and fascia layers broken down but they always reunited within a few weeks without rectocele formation, provided the levators were properly united.

At times the tear or episiotomy or the extension of the same does not reach high enough, thus impeding the isolation of the

posterior aspect of the levators; then the highest point of the tear (Fig. 1) is undermined in the same manner as heretofore and cut in the midline to the desired depth. All this can be done without assistance; in fact it is often as easily done as said because there is a yielding line of cleavage in primiparas. Up to this point the technic is similar to that of any perineorrhaphy except that here it is used immediately postpartum and without assistance. Not infrequently the tear assumes characteristics making the dissection of the mucous membrane unnecessary. With the isolation of the levators the problem remains how to get their thickness into the grasp of the tenaculum without retractor exposure, and a Gelpi retractor proves an encumbrance in such perineorrhaphies. It is then done as follows: The index finger of the left hand at the hindmost edge of the levator (Figs. 2, 3 and 4) pushes it outward and thus facilitates its inclusion in the grasp of the tenaculum. The same thing is done on the opposite levator. Pulling the tenaculum forward, the suture can embrace the whole depth of the levators. When working without an assistant the tenaculums are now removed and this first suture tied. (Fig. 4.) With finger pushing the levators forward, as before, the ends of this first suture, held between the thumb and second finger, are drawn taut while the upper and lower sutures are inserted including their posterior edges. (Fig. 4.) Three to five such sutures are necessary.

Before putting in the lowermost suture both levators are pulled upward, thus releasing and replacing the impacted and detracted levator fibers holding the anal sphincters. Incidentally, this elevates the lower segment of the tear helping to provide a thicker and firmer perineal base. It also affords a better chance for normal involution of the pelvic floor, and by depleting the engorged hemorrhoidal vessels minimizes the incidence of hemorrhoids. I employ this technic of pulling up the levators in chronic pelvic floor injuries. The fascia and skin are treated in the usual manner with the exception that when uniting the fascia, a few portions of the levator muscles are included. The same principle applies with relation to fascia and skin. This is to prevent a blind space forming in the presence of which the fascia and/or skin sutures infrequently break down. The continuation of the vaginal tear, left behind the levators after the sutures are tied unless it is extensive or bilateral, I leave alone.

In spite of the fact that frank tears and episiotomies are repaired we have a tremendous number of rectoceles and cystoceles with their cervico-uterine complications, etc. Perineorrhaphy instead of perineal repair is indicated. To do a perineorrhaphy takes seven or eight minutes longer than to do a perineal repair; and these are minutes well spent. I often complete the dissection of the mucosa, isolation of the levators and insertion of the levator sutures, without tying, while waiting for the placenta to separate.

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SPINAL ANESTHESIA AND THE SEVERELY WOUNDED*

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THE widespread reluctance to consider spinal anesthesia in the selection of an anesthetic procedure for the severely wounded is of deep concern to many of us who very strongly believe that there is a definite place for subarachnoid block for such type of injuries. This trend became very marked during the past year in which a number of articles on treatment of the severely wounded have completely rejected spinal anesthesia as suitable for them. Curiously enough in none of those articles were there given any statistical data to prove the point, namely, that spinal anesthesia was dangerous in such cases. As a matter of fact, in reports in which such statistical data were presented the figures dealing with spinal anesthesia invariably have shown a higher percentage of survival.

This paper is presented with the hope of giving an unbiased picture of results obtained with spinal anesthesia in substandard risks. Unfortunately, we have not had any war experience; in this we seem to be comparable with some of the recent investigators of this problem. We also shall have the temerity of not accepting as final the findings of our British colleagues. With our superior medical organization and a larger number of physicians available for our armed forces we have the right to expect a higher degree of efficiency in our military surgery than that of our allies or enemies. So far the medical reports on our troops are few. That is why we are forced to turn to the statistical data derived from civilian life, such as acute surgical emergencies including gunshot wounds of the abdomen and the obstetrical and gynecological emergencies, because such cases are in many respects similar to the wounds encountered in actual combat.

Our aim is to prove that under similar conditions spinal anesthesia is just as safe as any other form of anesthesia. Notwithstanding the tremendous progress in our surgical methods and technic, the mortality in abdominal wounds has remained practically unchanged during the last twenty-five years. Unquestionably, this is due in some degree to the fact that the fate of an abdominal wound depends not so much upon what can be done by the surgeon as what injuries have been caused by the action of the missile. The refusal on the part of the surgeon to recognize the benefit of spinal anesthesia may have been a factor in keeping our present mortality comparable to that of a quarter of a century ago. We fully realize the handicap that we are facing to substantiate our position. Evans,[1] writing on the anesthetizing of the wounded, specifies that "abdominal wounds required general anesthesia. The patient is usually shocked, and on this account spinal anesthesia is absolutely contraindicated." The J. A. M. A. in one of its recent editorials also emphasizes this point. Gordon-Taylor[2] speaking on amputations states that "in severe shock spinal anesthesia is certain euthanasia."* Beecher[3] also comes to the conclusion that "spinal anesthesia is poor choice for surgery for patient either in shock or in impending shock." We regret that in presenting his comparative statis-

* In contrast to that permit me to quote the title of the following article: Value of low spinal block analgesia in treatment of shock associated with wounds of lower extremities, by A. K. Boyle, Royal Army Med. Corps, 76: 339–340, June, 1941.

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tics he limits himself to the fall in blood pressure instead of showing the mortality for the corresponding groups.

Such a juxtaposition of shock and spinal anesthesia is decidedly unfair to the latter because under any conditions it is improper to operate upon a patient who is in shock. Permit me to quote here Sir John Fraser's[4] concluding words from his chapter on the evolution of the abdominal surgery of war: "The theme of this outline of evolution of abdominal surgery in warfare has been to show the necessity for early laparotomy. Lest this be interpreted as rushing the patient to the operating theatre on the earliest moment, . . . it may well be emphasized that such a practice is the antithesis of good judgement. All patients with abdominal wounds will benefit from periods of preoperative preparation devoted to improving the physical condition. . . . Associated with every case of abdominal wounding there is a measure of shock. . . . Experience has made it abundantly clear that a reasonable time devoted to resuscitation is time well spent." We are quite certain that under such conditions spinal anesthesia will prove to be at least equal to that of any other form of anesthesia.

Both spinal and general anesthesia have their advantages and disadvantages, and a skillfully administered general anesthesia may even be superior to spinal. But it requires a well trained anesthetist; it also requires a rather complicated and cumbersom equipment, although there is no reason why this should not be available even under the most trying conditions. Many of the advantages claimed for open ether anesthesia are fanciful and unsound. That the path of the anesthetist under war conditions is a thorny one is very pertinently illustrated by Muir[5] in his recent report on surgery in the Middle East: "Heat was unpleasant factor in East Africa. A shade temperature of 105–110°F. was common near Cheren. Ether boiled when the cork was removed from the bottle; gas was not available and chloroform became a necessity. It is not to be recommended for the shocked abdominal patient in whom the surgeon wants relaxation." As to the results of surgery under such conditions Muir states: "I do not think that the operative survival rate for penetrating abdominal wounds in the Middle East would be more than 20–30 per cent and probably less."

In contrast to this, spinal anesthesia, with its utmost simplicity of administration, provides the surgeon with an ideal relaxation so vital for this kind of surgery. With the present accent on youth in our armed forces spinal anesthesia gives our less experienced surgeons and anesthesiologists an opportunity to operate very expertly and expeditiously under most difficult circumstances. With blood transfusions, intravenous therapy, oxygen and the judicial use of vasoconstricting drugs the neurogenic shock of spinal anesthesia can be controlled. It can be easily and safely administered under the blistering sun of the Sahara Desert and in the blinding snowstorm of Alaska. All of the advantages of ordinary spinal anesthesia are increased manyfold by the use of the so-called sustained method as devised by Dr. Lemmon. This method permits the use of minimal quantities of the anesthetic agent and allows an individualization of the dosage, thus making it safe in substandard risks.

As to other references, Oberhelman and Le Count[6] report 61.5 per cent mortality in their series of 301 bullet wounds of abdomen. They rather vaguely state that "with few exceptions the anesthetic used was ether." Rippy[7] in his study reports a similar mortality of 61.9 per cent; ether also was his anesthetic of choice. Gordon-Taylor,[8] writing on the surgery of total warfare states that "approximately 50 per cent of the patients with abdominal wounds for whom operation is possible survive." Knowing his attitude toward spinal anesthesia and the general tenor of surgical opinion to it in Great Britain we take it for granted that most of the

operations were performed under general anesthesia. The higher rate of survival here may be attributed to the fact that the highest surgical and anesthetic talents were participating in the treatment of these patients. Rea[9] discussing the treatment of acute abdominal injuries employed at the University of Minnesota Hospital believes that "the type or length of anesthesia are not so important if the patient is given a transfusion during operation." His reported mortality is about 50 per cent. We must confess that so far we have not found any article in which spinal anesthesia is described as the sole anesthetic agent for penetrating wounds of the abdomen. However, in the articles in which both spinal and general anesthesia were used, spinal anesthesia invariably carried a higher rate of survival. Storck,[10] for example, confesses that "the absence of any deaths when spinal anesthesia was employed, either alone or in combination with ethylene or ether, is remarkable even though cases in which spinal anesthesia was employed were those in which there was not a pronounced preoperative depression of blood pressure (10 out of 40 cases)." Hamilton and Duncan[11] also are impressed with the results of spinal anesthesia: a 25 per cent mortality for spinal anesthesia against 43 per cent for general anesthesia. It is interesting that in spite of these rather encouraging figures no one as yet has used spinal anesthesia exclusively in this type of surgery. However, such data are available for other abdominal emergencies. Koster[12] in his report on sixty-nine cases of ectopic pregnancies emphasizes the importance of subarachnoid block for such surgery. In view of the fact that even so-called tragic cases have received spinal anesthesia his record of one death is truly noteworthy. Waters[13] who also uses a great deal of spinal anesthesia states that "it scarcely needs saying that we would have long since given it up had we found the dangers as remotely present as its antagonists contend." Inasmuch as his report deals with obstetrical and gynecological cases in which loss of blood is an always present danger, the nearly exclusive use of spinal anesthesia in his series of cases speaks for the safety of this method of anesthesia. Graham,[14] speaking on the treatment of perforated duodenal ulcers, strongly emphasizes the correlation between spinal anesthesia and the successful outcome of surgery. Strikingly enough he reports the lowest operative mortality: fifty-one consecutive cases with one death.

As to our personal experience with spinal anesthesia our attitude to it has undergone a considerable change in recent years. Our old objections to its use in shock or acute intestinal obstruction[15] are not valid any longer. In the light of an accumulated experience we have found spinal anesthesia perfectly safe in many desperate cases in which a few years ago we would not dare to employ this form of anesthesia.

This brings us to the most important part of our paper, namely, a plea to be more objective in our evaluation of spinal anesthesia. We have attempted to present a brief survey of the status of spinal anesthesia in acute abdominal surgery, both traumatic and non-traumatic. We are more than certain that spinal anesthesia, carefully administered and properly supervised, in many instances will obviate the difficulties associated with this surgery and enhance its results. We most emphatically disclaim the use of spinal anesthesia as the sole anesthetic method for such surgery. It is merely a plea to consider spinal anesthesia as an important member of our anesthetic armamentarium and not to neglect the benefits that may be derived from its use in acute abdominal surgery.

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Septicaemia and Bacteriaemia are due to the presence of organisms in the blood. In the former condition the organisms are not only present in the circulation, but actually proliferate therein.

FRACTURE OF TIBIA AND FIBULA TREATED BY T AND G BONE PLATE

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IT is now time to review our results of a year's use of the T and G bone plate, and to evaluate its worth, as well as to review our results and admit our errors. This article will deal only with its use, as well as its misuse on the tibia. The method of application has been thoroughly covered in the article, "Fallacies of Bone Plating," in the April 1943 issue of *The American Journal of Surgery*, but since that time two errors in its application have shown up:

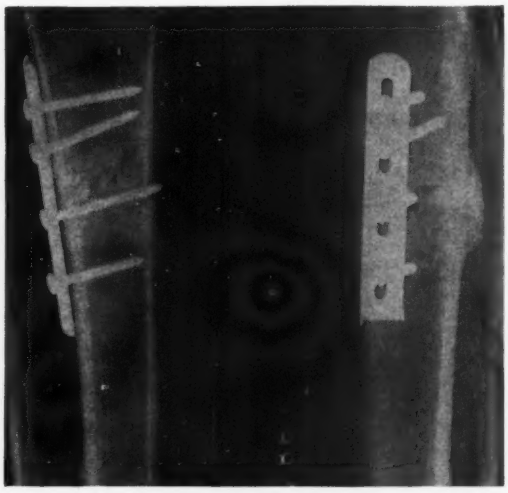

FIG. 1. Case 1. Error in plating. Screws were not put through both cortices. This *x*-ray was taken ten weeks after plating. Patient in walking cast ten weeks. Due to semirigid fixation, callus formed only posteriorly and laterally.

1. The plate must not be held against the bone with a clamp or bone forceps when it is applied, as the pressure may bend down the side walls and weaken its structural strength.

2. All the screw slots in the plate, especially over the fracture site, must be occupied by screws. The plate is, of course, weaker at the site of the screw slot and must be sustained by a screw to get maximum strength. This can be done by putting in a screw at an angle through the line of fracture.

We wish to emphasize what we said in the first article that plating must be done inside of five hours, or the case should be splinted temporarily and not plated for two weeks. The ideal results are obtained when immediate plating is used, but even here great care and judgment must be used to be sure that there is no damage to the skin over the tibial ridge. If in doubt, splint temporarily for two weeks and there will be no cause for regret. If plating is done after five hours and before twelve days, the operation is being done during the inflammatory period of repair. The results will be marked circulatory disturbances of the skin which will take three or four months to overcome, and a resultant marked decrease in callus formation and union, as our case reports will show.

Since time immemorable whenever poor results were obtained in a fracture of the lower tibia, our excuse has been, "what can you expect, the circulation is so poor." Now what lies behind this excuse, what is the explanation of this deficient circulation? We all know how famous, or rather infamous, the skin on the tibial ridge and medial border is for its persistent lack of healing power (ulcers, abrasions, etc.). This area of skin does not have an underlying secondary blood supply. We also know that periosteum relies on the overlying muscles and tissues to obtain its

secondary blood supply. So here on the tibial ridge we have an anachronism, a typical "No Man's Land," skin and periosteum both with inadequate secondary blood supply depending upon each other for help. The natural deduction, therefore, must be that the primary blood supply of both must be excellent in order to render aid to each other.

Thinking back, we remember that with our previous treatment of fractures with semi-rigid fixation, we obtained callus laterally and posteriorly early, but very late anteriorly and medially on the tibia. (Case 1.) In twenty-one of our cases plated within five hours or after fourteen days, we had rigid fixation and skin with normal circulation, and as a result had

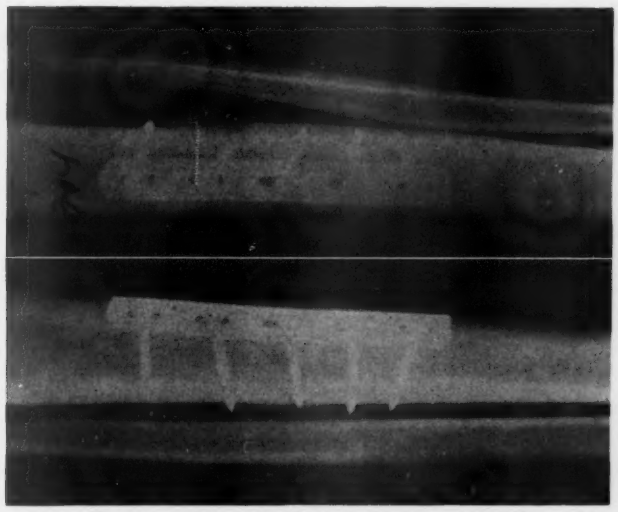

Fig. 2. Case II. Proper plating done on twelfth day. This *x*-ray was taken twelve days after plating. No cast was used. Callus formed on the anterior and medial borders as well as lateral and posterior edge. This patient returned to full duty in ten weeks.

Fig. 3A. Case III. 1, Fracture oblique plated on fourteenth day; 2, three weeks after plating; callus formation and obliteration of fracture lines; patient has full weight bearing. No cast or support was used.

plentiful callus showing in four weeks not only laterally and posteriorly, but also anteriorly and medially, and we also

Fig. 3b. Case iii. *X*-ray at nine weeks. Note callus on medial side over plate. Patient was on full duty eleven weeks after fracture.

obtained solid union in eight weeks. (Cases ii and iii.) When plating was done after five hours and before twelve days, we did not have normal circulation to the skin and as a result the skin in "No Man's Land" formed blebs and broke down. It took three to four months to heal as the periosteum did not get secondary blood supply and the resultant aftermath was that in four or five months we did not have solid union but only callus posteriorly and laterally. (Case i.) Therefore, not only is rigid fixation of the tibia necessary but also normal circulation over the tibial ridge and resultant good secondary blood supply to the periosteum in this region for early repair.

From the above, the logical deduction using and following the line of physiological reasoning must be that a compound fracture of the tibia should never be plated. We not only have destruction of the vital circulation but added to this the disaster of infection.

Fig. 4. Case iv. Oblique fracture of lower tibia. The patient also had the tibia fibular ligament torn. Note long lower screw through tibia into fibula holding fibula in place. This *x*-ray was taken fourth week after plating.

The skin incision should not be made so it extends onto the tibial ridge or the medial aspect of the tibia where the skin lies directly on the bone. A curved incision should be used on the lateral side and the plate should be applied to the lateral aspect so it will be covered by muscle.

CASE REPORTS AND STATISTICS

We wish to call attention to three facts as regards our reports: (1) When we speak of union, we mean not only clinical union, but complete union by *x*-ray or, in other words, complete obliteration of all fracture line. (2) That as part of the treatment all our patients are given ten to twenty days leave before returning to duty. (3) Return to duty in the Navy means the patient is fit for full manual labor.

Six tibias were plated within the five-hour period and all healed by first intention, had marked callus in four weeks and

Fig. 5. Case iv. Plate removed at three months as it was near joint. Note union and also callus on medial and anterior border of tibia. No cast or support used at any time.

union in eight weeks. The callus was anteriorly and medially as well as posteriorly and laterally. No casts or any type of support was used and the patients were allowed up on crutches in two weeks and were walking with a cane in four weeks. The average return to duty was eighty-eight days.

Fifteen tibias were temporarily splinted and plated after twelve days. They all had primary union and showed marked callus in three weeks and solid union in six to eight weeks. These fifteen patients were all on crutches in two weeks and walking with a cane in four weeks. They formed callus and had union ten to twelve days earlier than the previous patients so no time is lost in final results of the two weeks' delay. Nearly all of these patients had three weeks leave before return to duty. The average return to duty was three months and eighteen days.

One tibia was plated after thirty-six hours and after two weeks developed, not blebs, but epidermal cystic pockets of serum along the tibial ridge which had to be opened and drained. No infection was present but the skin healed adherent to the tibia. After three months these cystic pockets persisted and the skin had very poor circulation. Therefore, I was influenced by a dictum, "the foreign body was causing this reaction," and so I removed the plate. Due to poor circulation the wound became infected, and at four months the *x*-ray showed only callus posteriorly and laterally.

One tibia was plated after sixteen hours and healing of the skin was very slow. Edema of the leg persisted and even though non-weight bearing and an Unna paste boot was resorted to it was five months before the circulation returned to normal. At five months the plate was still holding and weight bearing was allowed, but the *x*-ray revealed callus formation but not solid union and the callus was only laterally and posteriorly.

One compound fracture was treated by débridement, lavage, "holypowder" and cast, and after four weeks apparently well

healed it was plated. But we had the usual story: the secondary circulation was so poor that after three weeks the wound broke down and became infected and the patient is now under the Orr treatment.

Comparison of Statistics. During 1941 we had forty-five cases of fracture of both bones of the lower leg. These patients were all treated by the two-pin technic and plaster walking cast. The earliest patient went to duty in five months and twenty-three days. The average return to duty was six and one-half months. This figure does not include the complicated cases.

In 1942, we plated twenty-four tibias, six within five hours, fifteen after twelve days, and the average return to duty was three months and eighteen days. One case, an office worker, forty-two years of age, went to duty in forty-seven days. As in the previous years' statistics the three with complications are not included.

In all six tibias that were plated within five hours we obtained excellent results without any excess callus formation. (Cases II and IV.) This is especially desirable in the case of women. However, in all tibias plated after twelve days excessive callus was thrown down causing a slightly larger limb at the site of fracture. (Case III.) This is, of course, not unusual in other methods of treatment.

CAUTIONS

1. Do not plate after five hours or before twelve days.
2. Do not plate when the skin area in "No Man's Land" is not normal and lacks normal circulation.
3. Do not have the incision run into "No Man's Land."
4. Beware of careless plating and always obtain anatomic reduction and opposition of fragments.
5. A screw running obliquely through the line of fracture is desirable.
6. Always be sure to impact transverse fractures thoroughly before tightening the screws.
7. All slots in plate must be supported by a screw.

Only if careful plating is done, observing the above cautions, will the perfect results and the early union be obtained. In our hands, perfect reduction, early union, maintenance of full function have followed observance of these rules and have shortened the period of disability at least 50 per cent with perfect alignment and length.

We advise as a safety measure the application of a posterior plaster splint for four weeks and then an *x*-ray will substanciate removal of cast and full weight bearing.

Warning. Surgeons who have had considerable experience plating with the other types of plates and screws, may experience some difficulty with this plate and especially the screws, as the technic and method of its use violate all the previous rules, customs and principles. The technic is fully covered in the previous article, "Fallacies of Bone Plating," in the April 1943 issue of this publication.

AN OPERATION FOR PILONIDAL SINUSES

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THE transition of men from civilian life to active army occupations has produced a change in the concept of what is a satisfactory method of handling pilonidal sinuses. Simple or block excision of a pilonidal sinus, packed open and allowed to heal by growth of granulation tissue has been accepted as the safest surgical procedure in the past. A few surgeons attempted various methods of primary closure in selected cases. These methods varied from simple suture of the fat to the sacrococcygeal fascia to obliterate dead space, to the more complicated plastic flap closure as advocated by Lahey. Recently another type of closure, by cutting out a pad of fat on either wall and suturing the skin edges to the sacrococcygeal fascia has been advocated by DePrizio and McFee. This method is supplemented by skin graft over the sacrum, if needed. The reason, of course, for seeking new methods is because a really satisfactory closure of the cavity left in excising pilonidal sinuses has not yet been found.

Simple or block excision with closure by growth of granulation tissue requires weeks before the final discharge of the patient. This period varies with each patient according to the size of the sinuses, amount of adipose tissue present, and the degree of inflammatory reaction. The average time for complete healing according to most reports has been eight weeks. Some patients with small sinuses heal in four to five weeks. Others have taken as long as a year.

Primary closures, as such, can be used only in selected cases. These cases are few in comparison with the total number of operated sinuses. When they become infected, as they eventually do, if they develop dead space or a hematoma or both, the period of healing is usually prolonged (over the above group of patients). Most surgeons have had comparatively poor results with primary closures as infections or hematoma develop in as high as 35 per cent of operations. Frequently these are called recurrences. It is believed the condition is not a true recurrence of cyst tissue or even due to the failure to excise cyst tissue. Excision of recurrences in a series of patients reported by Rogers demonstrated the absence of any epithelial tissue in the specimens and showed the so-called recurrences to be due to infected dead space.

The operative procedure advocated by DePrizio and by McFee removed the fat pad from over the sacrum. Lahey called attention to the fact, in 1929, that scar tissue covering for a weight bearing surface is a frequent cause of pain and discomfort while sitting. We have seen two patients who were totally disabled for their army occupation, riding in trucks or jeeps, by the above type of procedure. A personal communication from Lt. Col. Hamilton of the Camp Claiborne Station Hospital to the effect that the complaint of pain on pressure over the sacrum both above and below the site of operation is a frequent sequela following excision of the fat pad, confirms our observation. The army routine, for the vast majority, is a much more active life than previously experienced. The individual is subject to much more trauma especially over the sacrum. While engaged in active field work the opportunities for bathing are greatly reduced. Hence the combination of trauma plus dirt has caused many previously quiescent pilonidal sinuses to flare up with definite abscesses. Lahey stated that he had seen scar tissue break down and become necrotic as a result

of the trauma in this area. Many of the patients seen in army Station Hospitals have been those who have had previously

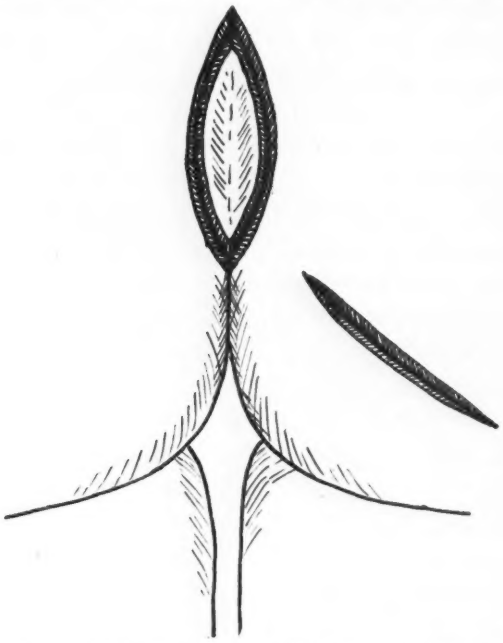

Fig. 1. Incision for pilonidal sinus and lateral gluteal incision for raising muscle flap.

successful excision of their sinuses with no closure attempted. Some of these patients had been operated upon years before with no complications until entering the army. Therefore, it would seem that perhaps one must re-evaluate operative procedures. If an operative scar cannot stand trauma, it may not be a really successful procedure. Certainly, the wounds left open have more scar tissue after final healing than a primarily closed wound. It is therefore, more apt to develop complications under the stress of trauma than the latter procedures.

In civilian life, the patient who has a slowly granulating wound may be out of the hospital in three to eight days and back at work. Army life places such demands on the average soldier that he must be physically fit. Hence his wound must be healed and strong enough to resist trauma, increased perspiration, and opportunities of infection before he can be discharged from the hospital. The hospitalization, therefore, must not only cover his wound healing, but also give a chance for the scar to become firm enough to resist the above conditions. This, on the average, means months of hospitalization.

It is a well known fact that fat has a

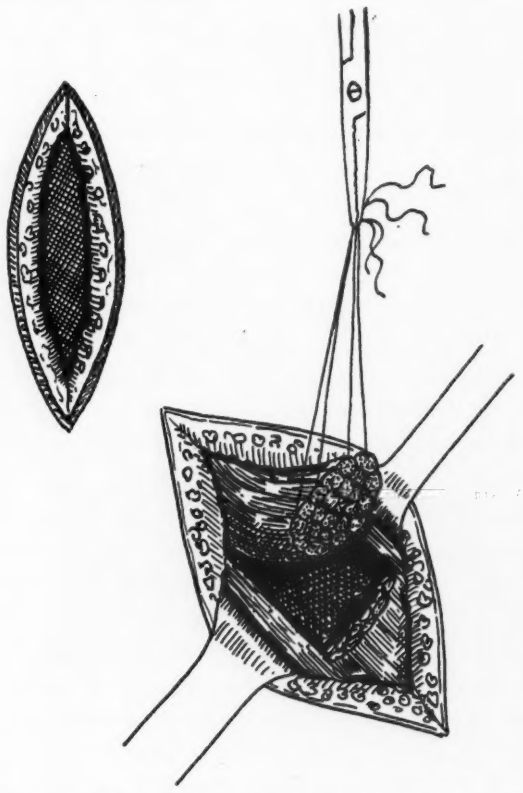

Fig. 2. Flap of gluteus maximus muscle cut and raised from bed.

poor blood supply and has very low resistance to infection. Scar tissue also has markedly decreased vascularity. It was believed, therefore, that if a tissue with an adequate blood supply, resistant to infection could be transplanted to fill the space left by the excision of the cyst, it might improve the healing, decrease the chances of infection and obliterate the dead space. It would also protect the sacrum with an adequate pad. On this basis of reasoning the following operation was tried on a patient:

Under spinal anesthesia, the pilonidal sinus was excised with an electric knife according to the method advocated by Rogers. This left a moderate size cavity extending over the lower sacrum and coccyx and exposing the sacrococcygeal fascia. This wound was packed with saline packing and a three-inch incision was

made laterally just above the ischial tuberosity in the line of fibers of the gluteus maximus muscle. The muscle was dissected free of fat, exposing an area as wide as the cavity was long. A flap of muscle sufficiently thick almost to fill the cavity and long enough to be turned over and reach the opposite wall of the cavity without tension, was freed as shown in Figure 2. A tunnel was then fashioned in the fat tissue under the intervening skin and the free muscle end passed through it. The proximal end of the muscle was left intact, using it as a pedicle flap. The muscle flap filled the cavity to just below the skin edges. Cotton sutures were taken through the base of the lower and upper angles and two along the intact lateral wall. The skin was then closed loosely. The gluteal incision was closed with deep and superficial cotton sutures to obliterate dead space and the skin closed with cotton. A pressure dressing with a sea sponge completed the procedure.

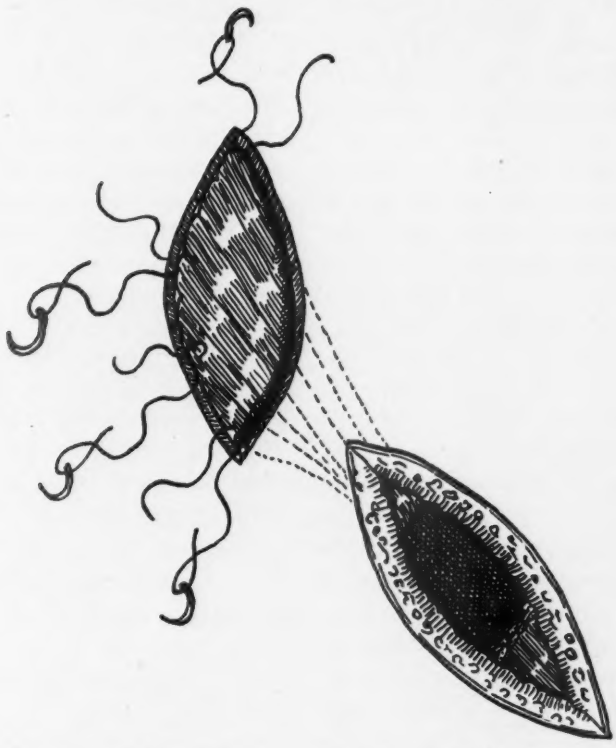

Fig. 3. Pedicle muscle flap passed through subcutaneous tunnel and sutured in place in cavity left by removal of pilonidal sinuses.

We did not cut any large arteries and the blood and nerve supply was still intact at the end of the procedure. The gluteus maximus muscle has a very adequate blood supply from the inferior and superior gluteal arteries and it was reasoned that the excellent vascularity would promote healing and combat infection, while the intact nerve supply might prevent subsequent atrophy and fibrosis of the pedicle flap.

This procedure has been performed by the author on six patients at the Station Hospital, Camp Claiborne, Louisiana. A short summary of their postoperative course is appended:

J. S. was operated upon February 27, 1943. A primary closure was attempted. There was a slight serous discharge with an odor on the fourth postoperative day. The sutures were removed and the wound opened down to the muscle. There was no infection present but a moderate necrosis of the subcutaneous tissue presumably secondary to the use of the electric

knife. The wound was cleaned and left open. On the seventh postoperative day, the incision over the ischial tuberosity was healed and the sutures were removed. The sacral wound was clean and without odor or discharge. By the fourteenth postoperative day the sacral wound was healed and epethelizing. This wound was entirely healed on the eighteenth postoperative day with a solid scar.

W. B. was operated upon March 15, 1943. A delayed primary closure was attempted on March 16, 1943. The gluteal wound healed by primary union in seven days. The sacral wound showed some redness of the skin edges when dressed on the fourth postoperative day. The sutures were removed and a small hematoma was found to have formed between the upper surface of the muscle flap and the subcutaneous tissues of the dermis. This was evacuated. The wound was dressed again on the sixth postoperative day and it was clean without any odor or discharge and healing. This wound was all healed except for the upper angle by the fourteenth day postoperatively. The upper angle of the wound had a deep coagulation of the entire skin thickness and subcutaneous tissues due to an error in technic in the use of the electric knife. This area slowly sloughed out and healed to a depth of about an inch by granulation. This wound took the longest to heal completely, about thirty days due to this error.

M. K. was operated upon March 15, 1943. In the previous two patients, the remaining muscle from which the pedicle flap was removed had the cut ends sutured. M. K.'s cut muscle ends were not sutured because the field was dry when the gluteal wound was closed by delayed primary closure. A two day delayed closure was tried in an effort to avoid the hematoma and serous discharge. The latter was incidental to the use of the electric knife in the block excision. The muscle ends of the pedicle flap constantly oozed during the operations and no attempt was made to control this. It was believed that any suture to the muscle to control this oozing would result in muscle necrosis. On March 18, 1943, the acriflavine gauze packing was removed from both wounds. The wounds were clean and had no odor. There had been considerable oozing of blood judging from the dressings. The sutures which were inserted at the time of operation were tied. Three days later there was a foul smelling discharge from the sacral wound. The sutures were removed from this wound. The gluteal wound looked clean. On March 22nd, two days later, the sacral wound was clean and healing, but the gluteal wound was indurated. Probing revealed a hematoma. The sutures were removed and the hematoma evacuated. The gluteal wound healed uneventfully following this but the sacral wound developed a deep stitch abscess where the muscle flap had been sutured, which was evacuated and the cotton suture removed. These wounds were healed, despite the complications, by the twenty-first postoperative day.

W. S. was operated upon March 17, 1943. A delayed primary closure was performed on both wounds on March 18, 1943. The sacral wound of this patient was healed and epethelizing by March 23rd. Again the cut muscle ends of the gluteus maximus, remaining *in situ*, were not sutured and again a hematoma formed in the gluteal wound and had to be evacuated. This wound took longer to heal due to the complications than the sacral wound.

The postoperative courses in these four patients apparently showed that the cut muscle ends of the gluteus maximus should be sutured even though apparently dry. The electric knife seemed to be contraindicated in the original block dissection because it caused subsequent edema. The oozing of the transplanted muscle contraindicated primary closure. The healing was so rapid even after the wounds were opened that it suggested the advisability of leaving the sacral wounds open, not even attempting a delayed primary closure.

Two patients who had undergone one and two previous operations, respectively, were operated upon with the removal of a large area of chronic inflammatory tissue, leaving a wound extending from the sacrum down to the anal canal exposing rectum and laterally well over the gluteal muscles. Large flaps of gluteal muscle were sutured into these cavities. Due to their large size, it was possible to cover the length of the cavity, but only about half filling their depth. The sacral wounds were left open and lightly filled with acriflavine gauze packing.

Both these patients developed hematomas in their gluteal wounds. Both were put on sulfanilamide therapy. Dressings on the second and fourth day showed the sacral wounds, which were not sutured, healing and clean. The gluteal wound of one patient became infected, the other was not infected. The encouraging feature was the clean sacral wounds which had already started healing. A check on the tenth postoperative day showed both sacral wounds clean and nearly closed.

Sulfanilamide, orally, was used in the first patient operated upon. No sulfanilamide therapy was used in the next three patients in an effort to evaluate the effect of the increased vascularity on infection. Sulfanilamide therapy, orally, was used in the two patients operated upon for recurrences.

This report shows we did not succeed in performing one primary closure. However, these patients cleared their infections and hematomas rapidly. There was apparently no marked loss of time due to failure of primary closure. The first four patients all entered the hospital with acutely infected cysts. Three to four days were allowed to elapse before operation. A longer time was indicated. The scars of the two healed patients were narrow linear scars. There was a good pad over the sacrum. The patients were asked particularly if this pad felt uncomfortable. Each answered in the negative. A striking feature in the postoperative course was the lack of bad odor and sloughing. In the case in which it was present, the odor disappeared within two days after opening the wound. We present this paper as a preliminary report describing the operation. It was thought the procedure showed enough promise to warrant this early report in the hope that a larger experience could be obtained from other surgeons.

Whether this procedure will stand up under the stress and trauma of army life can only be decided after a long follow-up. A follow-up by the average station hospital on operated cases can scarcely be longer than six months. New procedures evaluated on the basis of short postoperative observation may have to be revised after analyzing statistics from a number of station hospital records. Camp Claiborne Station Hospital has received a number of patients, apparently successfully operated upon within a period of six months, and showing sinus recurrence on admission. The recurrence was usually apparent only one to two days prior to admission. Consequently, all reports must be analyzed critically from this viewpoint.

In the small series of patients operated upon, several points in this technic seem quite important: (1) The muscle flap must be adequate to fill the cavity, and the subcutaneous canal large enough not to constrict the muscle and decrease its vascularity. (2) The floor of the canal should be flush with the surface of the sacrococcygeal fascia to obliterate adequately dead space. (3) The block dissections of the sinus should be performed with the scalpel. (4) Leaving the sacral wound open and obtaining approximation of the skin edges by adhesive strapping seems to be the procedure of choice. This seems indicated because the oozing from the cut muscle ends invariably formed hematomas in the closed wounds.

SUMMARY

A preliminary report is presented to give a procedure that shows promise in the operative treatment of pilonidal sinuses.

I wish to express my appreciation to Colonel Lucius F. Wright, Commanding Officer, Camp Caliborne Station Hospital for his permission to conduct this work; Lieut. Col. A. Scott Hamilton, Chief of the Surgical Service, for his hearty co-operation and helpful advice, also Colonel Leonard N. Swanson, Commanding Officer, 14th Evacuating Hospital, for the assignment to the Station Hospital and his keen interest in this problem.

RETROPERITONEAL MUCOCELE OF THE APPENDIX

CASE REPORT

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MUCOCELE of the appendix is the name applied to a condition in which there is an accumulation of mucoid material either in the lumen, the wall, or in a diverticulum of the appendiceal wall. When it ruptures it produces the condition called pseudomyxoma peritonei. The latter may also be caused by the rupture of certain types of ovarian cysts.

The following case is described not only because of the rarity of the disease but because of the large size and the most unusual position of the mass. The location of the mucocele adds one more condition to be considered in a differential diagnosis of right-sided tumor masses, particularly when retroperitoneal.

CASE REPORT

W. P., male, age seventy-two, widower, was first seen October 7, 1940. His chief complaint was attacks of pain in the right side of the abdomen, increasing in frequency and severity for the past two years. During the past week he had two severe attacks which persisted for twelve to twenty-four hours and had been accompanied by nausea but no vomiting. He had noticed some tenderness in his right side during the past year and thought his right side was enlarging slowly. His bowels had always been constipated and he used laxatives regularly. There had been no urinary disturbances. His weight had not changed during the past five years.

The past history revealed nothing of note except that at the age of about thirty years he had an attack of severe pain in the right lower quadrant which had gradually subsided but which had disabled him for several weeks.

Examination revealed a rather thin white male about seventy years of age, seventy-two inches in height, weighing one hundred forty-five pounds. General examination was essentially negative with exception of the following.

The abdomen was moderately distended. The entire right side was definitely and uniformly bulging. There were no varicosities or visible peristalses. On palpation a mass was felt, firm but somewhat elastic, extending from the right groin to the costal margin and from the right flank posteriorly to the midline anteriorly. It was slightly movable. It did not move on respiration. Auscultation of the abdomen was normal.

Rectal examination was negative except for palpation of a firm rounded mass extending upward from just below the pelvic brim on the right side.

Blood count showed a moderate secondary anemia; hemoglobin (Sahli) 74 per cent, erythrocytes 3,850,000, leukocytes 9,200. The urinalysis was negative.

Intravenous pyelogram showed normal functioning kidneys with pelves and ureters of normal size and position. In these films could be seen a shadow extending upward from the right iliac fossa to above the costal margin and extending from the midline to the right flank. The psoas shadow was obliterated on the right. Throughout the shadow were diffuse areas interpreted as calcification.

Gastrointestinal series was normal with the exception of the examination of the colon. The cecum and ascending colon were displaced to the midline. On palpation they were somewhat movable but could not be replaced laterally. The outlines were regular, there were no filling defects or obstruction. The appendix could not be visualized.

The impression gained from the study of the history, examination and *x*-ray evidence was that the right-sided mass was retroperitoneal, was not renal nor intestinal in nature, and was probably not malignant because of the size, duration, and generally good condition of the patient. Because of the considerations, it was advised that he undergo operation.

Operation was performed October 18, 1940, at the Lutheran Hospital, Moline, Illinois, (Case No. 46,122) under novocaine spinal anesthesia, assisted by Dr. H. C. DeBourcy.

A right kidney incision was used extending the incision forward to about 4 cm. below and anterior to the anterior spine. The peritoneal cavity was not opened at any stage of the operation.

The retroperitoneal mass was exposed carefully and found to be cystic in nature. It extended upward far above the costal margin, covering the entire anterior surface of the right kidney and the ureter, downward to below the brim of the pelvis and medially to the midline where its anterior and medial walls were in close apposition to the colon and peritoneum.

The cyst could not be removed intact because of its size and the friable nature of its wall. On attempting to aspirate, much difficulty was encountered because of the thick and tenacious character of its contents. The contents varied from clear thick mucoid material to thick grayish material in suspension resembling fish eggs. After the contents were removed, the wall was freed without great difficulty beginning above, working downward carefully to avoid injury to adjacent structures. As the right iliac fossa was reached the large cystic sac suddenly narrowed to a tube, firm, muscular, lead pencil in diameter and about 8 cm. in length. This was followed to its origin which proved to lead to the cecum at the end of the tenia libera, where it was clamped and ligated.

Up to this point no diagnosis had been made as to the cyst origin. It was now clear we had to deal with an enormous mucocele of the appendix, retroperitoneal in location.

The incision was sutured in layers with chromic catgut, one penrose tube being placed to drain the cavity.

Convalescence was uneventful, the patient being discharged from the hospital November 3, 1940, in good condition but with slight drainage from his wound. This persisted for six weeks when it finally healed and has remained so. When last heard from October, 1942, he was in good health.

The laboratory report of Dr. M. J. Vollmer, pathologist of the Lutheran Hospital, was as follows: "The gross specimen, cyst wall, weighed 212 grams, the mass being made up of the thickened wall of a cavity holding mucoid material. Bits of myxomatous tissue still adhere to its inner surface. Parts of the wall show calcareous deposits.

"Microscopically the sections show mucous deposits in the tissue cells. There is an inflammatory process accompanying, producing adhesions, but there is no invasion into surrounding organs. The sections of the small tube appear to be an appendix-like structure showing a circle of lymphatic tissue, but there are no glands of the normal mucosa. Here the connective tissue has increased greatly but there does not appear to be any neoplastic change. There is myxomatous degeneration but not the appearance of the mucous tissue as found in the cyst wall proper. Diagnosis: Retroperitoneal mucocele of the appendix."

Mucocele of the appendix was first described as a pathologic entity by Rokitansky in 1842. Virchow, in 1863, considered it a colloidal degeneration of the appendix. Werth, in 1884, described the finding of mucoid material in the peritoneal cavity and ascribed it to the rupture of a pseudomucinous cyst of the ovary. Fränkel, in 1901, described the same condition due to a ruptured cystic appendix in a male patient. In 1916, Dodge was able to find only 142 cases in the literature. Ninety authentic cases of pseudomyxoma peritonei of appendiceal origin were reported by D'Aunay and Fine in 1934.

Castle in 13,158 necropsies reported .2 per cent mucoceles. Normant in 45,000 Mayo Clinic cases found thirty-six mucoceles. Mayo and Foster report seventy-six cases in 31,200 appendectomies from 1917 to 1930. Jirka and Scuderi in 1938 reporting Cook County Hospital cases found four at 9,180 postmortem examinations and twenty-two mucoceles in 9,535 appendectomies, in the years 1929 to 1937. Weaver, in 1937, found seven cases in 6,225 operations and reported 256 cases from the literature.

Age probably has no etiological significance, cases having been reported from four years to over seventy-two years. Most cases, however, occur after middle age.

Woodruff and McDonald report seventy-nine cases in females and fifty-seven in males, a ratio of females to males of 1.4 to 1.0. Latimer reports the ratio of females to males as being one to two.

A stenosis of the appendiceal lumen usually caused by an inflammatory process produces an occlusion which holds back the glandular secretion. This in the presence of relatively sterile contents slowly produces a mucocele. Most cases will probably be found to have had old or recent inflammatory attacks which have regressed. Occasionally, malignant changes in the wall or a kink will produce the condition. Doyle speaks of a normal obliteration of the mucosa of the appendix after middle age, which if it begins near the cecum causes an obstruction which may lead to mucocele formation.

Naeslund was able to produce the condition experimentally in newborn rabbits by ligation of the appendix. The appendix was severed distal to the ligature leaving the distal stump open. In most cases small mucous cysts lined with epithelium were formed. Some of these burst and mucous material spread over the peritoneum. Phemister was unable to produce cysts by ligation of the appendix in dogs. Wangensteen, by a ligation method, was able to produce an acute appendicitis, but did not report chronic cystic formation.

Practically all cases show evidence of old or recent attacks of inflammation in the wall of the appendix. Most cases show evidence of stricture resulting from these inflammatory attacks. The majority of cases give a history of preceding appendiceal attacks. Inflammation is the most definite and most frequent factor in the production of a mucocele.

Grossly the size varies from a normal sized appendix to one of the great size encountered in this report. The shape varies according to the size and location of the cystic areas. The color and consistency vary from normal to grayish white and from normal softness to firm distention with hyaline changes in the walls. There may be softened areas, preliminary to rupture, or actual rupture with extrusion of the mucoid contents into the peritoneal cavity.

Histologically, simple mucoceles vary from almost normal mucous membrane to thin, membrane-like walls filled with hyaline. There is usually a predominance of mucous cells. There may be areas of wall where cell changes of adenocarcinoma have occurred. It has been suggested by Woodruff that the cases of the pseudomyxoma peritonei which run a fatal course are of this type. In the simple type, rupture into the peritoneal cavity before or during operation is usually benign in its course.

The symptoms of mucocele are very vague and indefinite. A preoperative diagnosis has rarely been made. Lifvendahl reports such a case.

A dull pain in the right lower quadrant associated possibly with some digestive or bowel disturbance has been noted frequently. A palpable mass, when the mucocele is of some size, may be noticed by the patient. This was observed in a previous case reported by the author.

The physical findings are few. Of main interest is the palpation of a mass usually in the right side of the abdomen. It may be fixed or movable, firm and elongated or rounded in shape.

X-ray may reveal a filling defect of the cecum, sometimes a partial filling of the appendiceal cyst. Pugh reports multiple areas of calcification in a case of pseudomyxoma peritonei.

The diagnosis is based upon a past history of preceding attacks of appendicitis, indefinite abdominal distress with often a palpable mass in the right side which may be fixed or movable, and of varying shapes and sizes, but usually long and sausage shaped, and negative *x*-ray and urological evidence of the more frequent causes of the symptomatology. Most cases have been diagnosed at laparotomy, often done for entirely different lesions, the

mucocele having been discovered as an incidental finding, particularly those of small size. Recently Pugh has described a case in which characteristic findings of calcification in multiple cysts of the peritoneum were noticed on *x*-ray.

The treatment is entirely surgical and varies from simple appendectomy to more extensive resections of the cecum and ileocecal region in complicated cases. Where a simple mucocele has ruptured, mopping up of the mucoid material may be sufficient. In a more extensive and probably malignant degeneration, it may be impossible to remove even a small portion of the exudate. Radiation therapy postoperatively may be of some value, but usually gives no permanent benefit.

SUMMARY

1. A retroperitoneal, retrocecal mucocele of the appendix of great size was successfully removed in a patient seventy-two years of age.

2. The size and retrocecal location are unusual and rare.

3. Mucocele of the appendix must be considered in a differential diagnosis of right-sided masses both abdominal and retroperitoneal.

4. A résumé of the literature and fairly complete bibliography are given.

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LATERAL OSTEOTOMY

ANATOMICAL CONSIDERATIONS

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THROUGH the courtesy of the Museum of Natural History 1,000 of its very large collection of skulls were examined. They present the anatomical basis of this paper. The skulls examined included specimens of all peoples extant today, and extended backward to earliest civilization. Included in the specimens studied were the early Egyptians, Romans, Biblical peoples, prehistoric Indians of both North and South America, peoples of the Orient and the South Pacific, Esquimaux, etc.

The purpose of this paper is threefold: (1) To describe, we believe for the first time, the site of a groove located on the frontal process of the maxilla. We, of the Fomon group in New York have long been using this groove as an aid, and guide in the practical matters of operative technic. It is, therefore, of more than just academic interest. (2) To stress the surgical importance of this groove. It is the guide for the correct anatomical selection of the lateral osteotomy line in plastic reconstructive surgery. It is well known that the lateral osteotomy not done anatomically correct will leave a ridge of bone *in situ* which on healing causes an ugly facial disfigurement. (3) To present other points of anatomical interest having a bearing on the lateral osteotomy.

The aforementioned groove is present to a greater or lesser degree in all skulls. At times its presence is barely indicated on the surface of the bone, at other times it is deep and definite. While its length, depth, and width are variable, its direction is quite constant in all the skulls studied. To determine its direction we first take point "A," which lies on the suture line between the two nasal bones, and approximately 2 mm. caudal to the root of the nose. (Fig. 1.) Our second point "C" lies about midway between the margin of the pyriform aperture closest to the infra-orbital foramen, and the foramen itself. A line joining points A and C shows the direction of the groove. The actual groove does not extend the entire length of this line since it usually does not extend onto the nasal bones themselves. It terminates at point "B" on the maxillary bone so that the groove proper is the line BC.) If an attempt is made to mark this line with ink on the surface of the skull, it will be found necessary to draw the line slightly arced upward to compensate for the convex surface of the bone. It is precisely this convexity of the surface of the bone which leads to mechanical difficulties in the actual sawing processes, unless it is recognized and compensated for by a rocking or see-saw manipulation of the saw. We made several hundred measurements to determine the average angle of this arc, but the results were very inconclusive and of no practical value.

There are no people either among the ancients or moderns, whose skulls as a rule showed exceptionally developed grooves. It was thought people with high dorsal nasal projections would have deep grooves, but this also is not true. We found that prehistoric Indians of Arizona and New Mexico, whose dorsal nasal projection was not marked, often had deep, wide grooves. In the Flathead Indians, and surprisingly in the Chinooks of Oregon deep grooves are common. The same is true of the Chinese, Esquimaux, Polynesian, and Negroid peoples

in whose skulls we expected to find very faint, if any, grooves. On the other hand, the ancient Greeks, Romans, and Near East people, whose aquiline nasal features led us to expect the presence of deep grooves, had at times only the faintest indication of their presence.

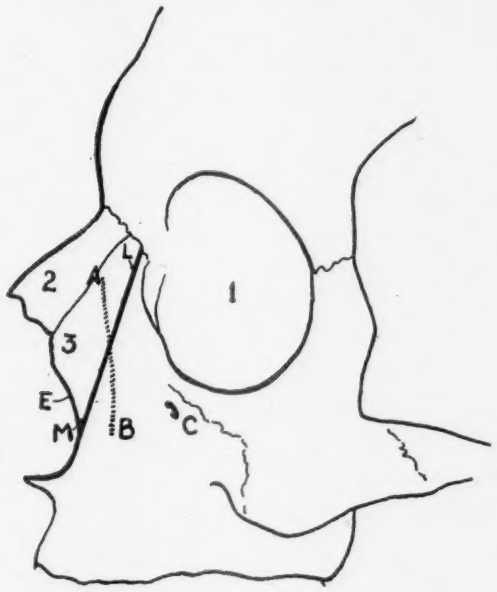

Fig. 1. AB, groove; C, infra-orbital canal; 1, orbit; 2, nasal bone; 3, maxilla frontal process; LM, ideal osteotomy line; E, margin pyriform aperture.

The groove averages about one and one-quarter inches in length. It is never identical on both sides of the skull or in any two skulls. The direction as already noted is always constant with only slight variations. The depth, width, and sharpness of the groove is variable. Most frequently the groove is widest, and deepest in its middle third. Rarely does the groove extend through the masomaxillary suture onto the nasal bone, but usually merges imperceptibly with the bone of the maxilla about one-eighth inch below the suture line. Caudally the groove also merges imperceptibly into the surrounding bone. It will be noted that the groove does not contact the margin of the pyriform aperture at any point. This is most important to remember.

The practical value of the groove appeared to be in the fact that once the bed for the lateral osteotomy had been prepared, it would only be necessary to feel the groove with the blade of the saw to have a fixed, anatomical landmark for purposes of orientation. This has been found of practical value in those instance. in which it is possible to feel the grooves In many instances where, for example, the lateral osteotomy is too small, or the groove is too indefinite and so cannot be felt, the knowledge of the anatomy of this region occasioned by a comparative study of the groove is a sufficient basis for an accurate lateral osteotomy.

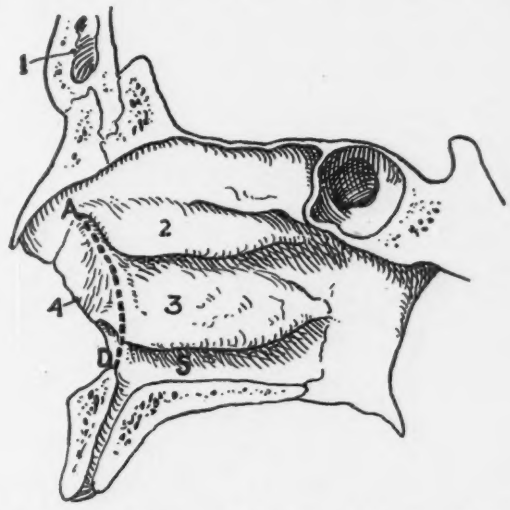

Fig. 2. Sagittal section of nose. 1, frontal sinus; middle turbinate; 3, inferior turbinate; 4, 2, margin pyriform aperture; 5, inferior meatus; AD, ridge following internal course of ideal osteotomy line.

The importance of the groove lies in its middle third, the depression of which can usually be felt with the saw and so establishes the most important middle third of both the osteotomy sawing line and the height of the convexity of the surface of the maxilla. This middle third of the groove always lies directly anterior to and above what we believe to be the ideal lateral osteotomy line.

This ideal osteotomy line can be seen as a thickened ridge of bone on the inner surface of the frontal process of the maxilla when a skull is held up to the light and viewed from the inside of the nasal chamber. This line is a ridge which can be

felt with the finger. It is triangular in shape with a blunt apex. The thin bone at the anterior margin of this ridge follows the line of the ideal osteotomy cut. This can easily be shown by holding any skull up to the light and tracing in ink on the outside of the skull the anterior margin of this ridge. Viewed from the interior of the nose against the light, the silhouette of this thickened ridge is in sharp contrast to the thin bone bordering it on either side. This ridge is continuous at its origin with the insertion of the anterior tip of the middle turbinate into the maxilla. (Fig. 2A). It then runs (B) obliquely downward and anteriorly to pass behind the junction of the anterior fifth with the posterior four-fifths of the inferior turbinate (C). Below the inferior turbinate the ridge again appears in the lateral wall of the inferior meatus (D). It then continues in its downward path to merge into the sharp margin of the pyriform aperture (E). This line drawn on the outside of the skull will always coincide with the middle third of the groove, but the drawing of this line follows the thin bone at the anterior margin of the thick ridge. Now it will be seen that the upper third of the ideal osteotomy line lies somewhat lateral to the groove while the lower third of this ideal line, since it cuts through the margin of the pyriform aperture, must lie medial to the lower third of the groove. In Figure LM shows the position of the ideal osteotomy line drawn on the outside of the skull and its relationship to the groove.

Thus anatomically the middle third of the groove acts as a fixed point for the lateral osteotomy. Once having established this point, the two variable points become the two ends of the saw and their direction depends on whether we wish more or less narrowing of the nose. Thus, the closer to the inner canthus of the eye the tip of the saw is brought, the greater will be the narrowing effect, while the closer it approaches the glabella the less the narrowing. The heel of the saw can be placed in contact with the margin of the pyriform aperture at its lowest level. This positioning can be felt against the aperture margin. However, it is not necessary that the lateral osteotomy cut through the pyriform aperture for a successful narrowing. The lowermost part of the osteotomy line can be more than an eighth of an inch away from the pyriform margin should this be the desired sawing line. A successful narrowing in fracturing is always obtained because the fracturing will extend the lower end of the sawing line to the margin of the pyriform aperture.

There is only one more point to consider. We wish to make the lateral osteotomy so that it will correspond to the thin anterior margin of the thick internal ridge. If this is not done, the sawing will be made more difficult by having to saw through thick rather than through thin bone. To accomplish this purpose it is necessary to hold the saw not at the usual angle of 90 degrees to the surface being cut but at an angle of 120 degrees. In practice the flat of the saw is held almost flush to the plane of the body of the maxilla.

SUMMARY

1. A constant anatomical groove in the frontal process of the maxilla has been described.

2. The practical application of this groove to the lateral osteotomy has been shown.

COTTON SUTURE MATERIAL*

IMPORTANCE OF SURGICAL PRINCIPLES

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THE problems of wound healing necessarily receive additional attention in time of war. Improvements in technic have been, in a large measure, slowly evolved through knowledge gained in the care of war wounds. However, it is often questionable just how much progress has been made since the days of Ambrose Paré who, in the sixteenth century, appreciated the difference in healing between the gently cleansed wound and the wound cauterized with boiling oil. All too few are the surgeons who practice and teach the important surgical principles of wound healing. Rare—at least uncommon—are the fortunate who are painstakingly indoctrinated with those minute detailed principles of surgical technic which make excellent wound healing an expected result. Often the busy young surgeon has the knowledge but lacks the patience and practical wisdom necessary for its proper application. Too many are those who have been surgically reared on a "routine closure" who have been able to "get by" with careless and unjustifiable methods because of the remarkable ability of living tissue to withstand the trauma of the surgical team. Samuel L. Ledbetter, Jr.[1] has called attention to the fact that, "Wound healing is a natural cellular growth, and if the wound is not handicapped by necrotic tissue, foreign bodies, strangulating ligatures, blood clots, etc., it will heal spontaneously." We appreciate that the importance of surgical principles has been well presented in several fine articles during the past decade. Nevertheless, we believe, as Mont R. Reid[2] has pointed out, "—that a thorough knowledge of the principles of wound healing and its daily thoughtful application is of the most fundamental importance in the practice of surgery."

It is our belief that much of the recent literature has wrongly emphasized the advantage of one type of suture material over another without regard to the importance of gentleness in handling tissues, well placed incisions made with sharp blades, careful gentle sponging, adequate length of the incision necessitating only moderate retraction, identification of anatomical structures, meticulous hemostasis, use of small instruments and needles, and the proved fact that fine, non-absorbable sutures cause minimal tissue reaction.

The fundamental surgical principles formulated by Halsted[3] and repeatedly emphasized by Sumner L. Koch,[4,5,6] Michael L. Mason,[7,8,9] Allen O. Whipple,[10] Mont R. Reid,[2,11,12] and Samuel L. Ledbetter[1] must be rigidly adhered to if one expects to obtain best results with cotton suture material. To have been well trained in these sound surgical principles and possess the surgical philosophy to practice them are priceless possessions. All failures in clean wound healing should be considered a direct result of poor surgical technic and should be made a matter for serious, honest investigation. Each wound, surgical or accidental, offers an opportunity to improve our knowledge of wound repair.

In February, 1942, Dr. Robert Day, resident in surgery on Dr. Alton Ochsner's service at Charity Hospital, New Orleans, Louisiana, visited our operating room, and during his visit reminded us of the many virtues of cotton thread as a suture material. Ever striving to repair our wounds in as ideal a manner as possible, we familiarized ourselves with the literature on the

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use of cotton as a suture material and performed the first operation in this hospital using all cotton suture technic in March, 1942. Since that date we have used all cotton sutures in more than two hundred major operations with very gratifying results. However, the improvement noted in the closure of wounds in this series is attributed to an improved surgical technic on the part of the surgeons and is not due entirely to the thread used. The greatest advantage we have found in using cotton is its delicacy when compared with catgut, thus serving as a constant reminder that the operator should be more gentle in handling the suture as well as the tissues. When cotton is placed in the tissues correctly, the wounds heal faster, with minimal reaction, and with less discomfort to the patient. Our experience with cotton has taught us that the size of the suture and attention to minute details in placing the suture in the tissue is more important than the type of suture used.

Following the exhaustive experimental studies of William H. Meade and Alton Ochsner,[13] frequent reports have been published on the subject. William H. Meade and Carroll H. Long,[14] Phil Thorek,[15,16] C. A. Pannett,[17] S. Arthur Localio and J. William Hinton,[19] John E. Cannaday,[19] and E. A. Nixon[20] have emphasized the importance of the Halsted technic but none has suggested that the improvement noted in wound healing might be due, in the greater part, to a refined surgical technic. In support of our contention that a refined technic is more important than the type of suture used, the following instance is cited.

One of the authors, prior to entering Military Service, was well trained in the use of fine suture material, gentle handling of tissue, ligation of vessels with minimum surrounding tissue, meticulous hemostasis, and the use of interrupted sutures; the other's interest was largely gynecology, and a great many of his surgical principles were formulated while removing large fibroids with large sutures and taking large bites of tissue with large needles. On occasion after entering the Service we would do a bilateral hernia together, using identical suture material. On the cases we did together, any time during the postoperative period one could stand at the foot of the bed with the patient's dressings removed and tell at a glance the surgeon responsible for each wound. After switching to cotton, the technic of handling the tissues and placing the sutures was so improved by one of us that it was possible to stand at the foot of the bed in the same type of case and be unable to distinguish any difference in the operative wounds. The wounds of the plastic surgeon were only slightly improved; the wounds of the pelvic surgeon were greatly improved. There is little doubt that if we had used any other fine suture material as carefully as we used cotton in the cases herein reported, the results in wound healing would have been better than we were obtaining before using cotton.

Repeated emphasis on surgical principles and a refined surgical technic has included careful attention to every detail of the entire surgical procedure. No less important are adequate cleansing of the hands and forearms of the surgical team, appropriate masking of the face, including nose as well as mouth, proper preoperative preparation of the patient, and gentle, thorough preparation of the operative site, remembering also, "The good workman needs good tools." The site of incision is selected after studying the flexion creases in the area, keeping in mind the surgical pathology of the disease for which the patient is being operated, as well as the blood and nerve supply of the area. Each operation is treated as an individual problem, and an honest effort is made to keep from doing routine ritualistic procedures; a satisfactory explanation justifies each step.

The incision is made with a sharp scalpel and skin bleeders are clamped with small hemostats. Great care is exercised to pick up only the vessels, including a minimum

of surrounding tissue. The large bleeders in the subcutaneous tissue are clamped before dividing, when possible, and the portion of the vessel distal to the ligature is excised. As sponging is needed, the wound is gently blotted—never scrubbed. The vessels are ligated with fine plain cotton as the layers of the abdominal wall are traversed. Control of hemorrhage is accurately and carefully done, appreciating the difference between "ideal"[2] and complete hemostasis.

Gentleness in the handling of delicate tissue is the most important single part of the surgical technic. The gentle surgeon will not use large instruments, large sutures, ligate large portions of tissue to become necrotic and perhaps infected, tie sutures and ligatures too tightly, traumatically retract tissue or forcibly "scrub-sponge" a wound. Instead careful attention will be given to every detail of the operation. The surgeon who is at all times acutely conscious of the importance of doing no harm and adding no additional burden to the tissues will unconsciously follow the fundamental principles of good surgery, irrespective of the suture he employs.

Edward L. Howes and Samuel C. Harvey,[21] Charles H. Lupton,[22] and many others have proved that fine suture material causes minimal tissue reaction. The important additional advantages of cotton are its greater strength when moist, and minimum tendency of knots to slip because of the high coefficient of friction, allowing cutting close to the knot, and thereby reducing to a minimum the amount of foreign body left in the wound. Fine suture and ligature material will not permit traumatic mass ligation and strangulation of tissue even if the surgeon forgets. Multiple, well spaced, approximating and not strangulating sutures are made imperative. The importance of the careful placing of sutures and proper reapproximation of divided structures has been dramatically demonstrated by Jean Stevenson and Mont R. Reid[23] in their experiment in which the abdominal wounds of dogs were sutured by the traumatic and atraumatic method. Both wounds were reopened in five days; in one dog the wound was healing with minimal reaction; in the other dog many of the sutures had sloughed out following pressure necrosis. The uselessness of using a suture stronger than the tissue it coaptates is a well established but often disregarded fact. We have no "suture routine" such as No. 24 for this layer and No. 60 for another in certain operations. Instead, each operation is considered an individual one, the finest suture practicable being used. The suture selected for each layer is about equal in strength to the tissues it holds in apposition. Sizes 150 to 30 are always available, and the size selected depends upon the type of operation and the physical development of the individual;—greater strength in the anatomical structures severed requires greater strength in the suture used to reapproximate them. As Reid[2] advised, "Study each wound and then do what you think best," can be practiced in selecting the size of material to use in closing a wound with cotton.

The cases we are including in this series have been consecutive, unselected, and include perforated peptic ulcers, ruptured appendices, branchial cleft cysts, wound disruptions, thyroidectomies, thyroglossal duct cysts, cholecystectomies, hemorrhoidectomies, mastectomies, herniorrhaphies of all descriptions, and many types of accidental wounds. In all cases of perforated peptic ulcer, the wounds healed by primary union. In five cases of appendicitis with rupture the wounds healed by primary union in three cases and infection developed in two. In one of these infected cases a sinus developed. In 198 clean cases three of the wounds became infected, two of which progressed to sinus formation, making a total of three wounds in the entire series that developed a sinus, a phenomenon as yet unreported by any of the authorities employing cotton suture material. In fact, cotton, due to its structure, is supposed to reduce to a minimum the possibility of

sinus formation. Cotton, being a vegetable fiber, has a natural tendency to twist. This characteristic of the material eliminates interstices between its fibers and prevents granulation tissue from growing into the suture, a factor which has been advanced as the cause of sinus formation when silk is used. Although two of the three clean cases to develop wound infection were operated upon by other members of the staff, the results were so unusual, a brief description of all three cases is indicated. The fourth case report is that of the contaminated case in which a sinus was formed.

CASE REPORTS

Case I. F. A., a white male, age twenty-four, Hospital Register No. 24,630, was admitted to the hospital April 1, 1942. Operation for left inguinal hernia was performed on April 6, 1942. The operating surgeon had not familiarized himself with the technic of using cotton and in a hurry to complete the operation closed one layer with cotton and the next with catgut. Cotton was also used as a running suture.

The wound became infected, and on April 13th, the sixth postoperative day, 120 cc. of purulent material was drained from the wound. The wound drained profusely for two weeks, then gradually closed.

The patient was discharged May 22nd. He was readmitted to the hospital on July 20th and gave a history of, "Wound draining continuously since operation." Examination of the patient showed a sinus in the center of the operative scar.

On August 4th two white cotton sutures were removed from the bottom of the sinus and the wound promptly healed, approximately four months after operation.

Case II. C. G. L., a white male, age twenty-nine, Hospital Register No. 34,057, was admitted to the hospital July 8, 1942. Operation for left inguinal hernia using all cotton suture technic was performed on July 13th. The repair was done through a Babcock cutaneous incision, ligating the sac with No. 30 plain cotton suture and transplanting the stump beneath the fibers of the transversalis and internal oblique muscles. The inguinal canal was obliterated by coaptating the conjoined tendon and inguinal ligament with interrupted sutures of No. 30 white cotton. The cord was not transplanted. The operation lasted one hour and ten minutes.

On July 19th the wound became suppurative and purulent material obtained from the wound showed Staphlococcus albus. Drainage continued until October 14, 1942. On this date the entire wound was excised, including a sinus tract which extended down to the transversalis fascia, at the bottom of which were two No. 30 cotton sutures. The sutures were removed together with all chronic granulation tissue. This second operation was done by one of our colleagues, using catgut to repair the wound after thorough irrigation with a suspension of microcrystals of sulfathiazole.

The wound became indurated on the third postoperative day and purulent material escaped on the tenth day. The drainage was profuse for three weeks and then gradually ceased, allowing the wound to close.

The soldier was discharged to duty on December 16, 1942, following a hospital stay of more than five months because of the primary infection.

Case III. T. J. B., a white male, age twenty-five, Hospital Register No. 40,916, was admitted to the hospital and appendectomy performed on October 11, 1942, through a Rockey muscle splitting incision. The individual was obese and the appendix was located with difficulty. It was eight inches long, bound down with adhesions, and located retrocecally. Although the appendix was removed intact, the entire serosal layer was stripped off during the procedure. The spinal anesthetic wore off during the operation and had to be supplemented with inhalation anesthesia, prolonging the operation considerably. The operating time was one hour and fifty-five minutes.

On the tenth postoperative day the wound developed infection and drained purulent material which, on culture, showed Staphlococcus albus. The wound healed spontaneously and the patient was discharged to duty on the thirtieth postoperative day.

Although no gross contamination occurred in this case, the surgical technic was imperfect, and when infection developed, the operator was more chagrined than surprised.

Case IV. A. W., a colored male, age twenty-nine, Hospital Register No. 48,213, was admitted to the hospital December 22, 1942. He was operated upon for ruptured appendix on the day of admission. Frank pus was encountered in the peritoneal cavity. The appendix

was removed and 15 Gm. of sulfathiazole powder was placed in the abdominal cavity. Following closure of the peritoneum, the wound was irrigated with copious amounts of saline. Because of the obesity of the individual, a small drain was placed beneath the fascia of the external oblique muscle.

Following removal of the drain on the fourth postoperative day, purulent material flowed from the wound for several days and then gradually diminished except for one small area in the center which refused to heal. The sinus was probed with a crochet needle but no suture could be found. On February 15, 1943, the fifty-fourth postoperative day, the wound was opened and the sinus tract excised. The tract extended a distance of two and one-half to three inches to the deep layer of the superficial fascia, at the bottom of which was a small cotton suture. The sinus tract was lined with typical gelatinous granulation tissue. The remainder of the wound was firm and well healed.

Table 1

Contaminated Cases	Primary Union	Wound Infection	Sinus Formation
22	19	3	1

Clean Cases	Primary Union	Wound Infection	Sinus Formation
198	195	3	2

The infections which developed in our clean cases were a direct result of a violation of the principles of surgical technic discussed in this paper. Cotton was mixed with catgut and also employed as a running suture in the first case. In the second case, although no gross violation was visible, we are convinced that a break in technic occurred—perhaps improper preparation of the hands and forearms of the surgical team, or maybe a needle puncture of a gloved hand participating in the operation. The technic in the third case was admittedly very poor in many respects. The incision was cone shaped through an obese abdomen, and necessitated traumatic retraction. In removal the appendix was stripped from within its serosal layer; further, the operating time was unnecessarily prolonged because of the necessity of supplementing the spinal anesthetic. For a wound so treated to heal with minimum infection is the best that any surgeon could expect. Had such a wound healed by primary union, our study would serve no useful purpose. "The patient's best defense against infection lies in the perfection of the operator's technique."[24]

No mention has been made of the influence of the nutritional state of the patient on wound healing. We have operated on no patients in the extremes of life. All have been young, vigorous, healthy, military patients whose diets have been deficient in none of the elements which promote good wound healing. Further, all elective cases were *x*-rayed prior to operation to exclude chronic pulmonary disease and examined carefully to detect any other systemic disease contraindicating operation.

One striking feature we have noted in our cases is the low temperature on the first and second postoperative days. In medical school we were taught that this postoperative elevation was a natural phenomenon and was called "fibrin ferment fever." The postoperative febrile reaction has exceeded 99.5°F. in only a few instances. One other feature discovered during this study was that the patients were noticeably free of pain following operation, although no study has been made to determine if our series had less hypodermics of morphine following operation than a like number of patients whose wounds were sutured with catgut. It has been called to our attention, however, on more than one occasion, that an appendectomized patient required no hypodermics during the entire postoperative course.

Cotton has been suggested as an ideal war time suture material by Meade and Ochsner,[25] Thorek,[16] and Pannett.[17] However, it should be pointed out that a meticulous surgical technic, so necessary for success with cotton, is more time

consuming. The operating time has been increased in our series 15 to 20 per cent, a factor that requires serious consideration when operations are contemplated under battle conditions.

SUMMARY

The successful use of cotton suture material will depend upon strict attention to fundamental surgical principles. The use of a minimum of foreign material shares importance with gentleness in handling delicate tissues, meticulous hemostasis, accurate reapposition of divided structures without tension, and patient attention to technical details. When employed in compliance with these principles, cotton is an ideal suture material.

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PAIN IN THE SHOULDER AND UPPER EXTREMITY DUE TO SCALENUS ANTICUS SYNDROME

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THE purpose of this paper is to discuss symptoms and signs which are associated with the scalenus anticus syndrome.

Anatomy. The anterior scalene muscle arises from the anterior portion of the transverse processes of the third, fourth, fifth and sixth cervical vertebrae. It courses almost directly downward to be inserted at the scalene tubercle on the upper inner surface of the first rib. It is situated behind the subclavian vein and in front of the subclavian artery. The subclavian artery thus lies within the acute angle formed by the scalenus anticus muscle and first rib. The subclavian vein lies in front of the muscle and in the space between the first rib and the clavicle.

The trunks of the brachial plexus and the cervical sympathetic chain lie behind the medial surface of the muscle. At each level from the third to the sixth cervical segment a branch is supplied to innervate the muscle.

Thus, conditions which cause spasm or hypertrophy of the anterior scalenus muscle may cause pain by irritating: (1) The subclavian artery, (2) the brachial plexus, (3) the subclavian vein, and (4) the cervical sympathetics, or the vascular sympathetic fibers. Any of these structures may be irritated singly or in combination, often producing a mixed and confusing picture of pain and tenderness in the upper extremity. Narrowing of the costoclavicular space may also produce symptoms of vascular compression.

IRRITATION OF THE SUBCLAVIAN ARTERY

A spastic or hypertrophied scalenus muscle may narrow the acute angle formed by the muscle and the first rib. Since the subclavian artery lies within this angle it may be compressed, producing severe pain in the upper extremity. The hand and fingers may be cooler than those of the unaffected side. Oscillometric readings of the brachial artery show a diminished excursion as compared to the non-painful side. The patient complains of a dull heavy arm as though a weight were placed upon it, or perhaps a severe cramp-like ache. Often there is an associated sensation of numbness and tingling. The strength of the hand clasp is usually weakened.

Infiltration of the scalenus muscle with 2 cc. of 2 per cent procaine is usually followed by complete relief of pain in one to three minutes. The power of the hand grip increases in strength as soon as the pain subsides. The heavy sensation disappears.

CASE REPORT

A fifty-three year old male complained of severe pain in the left shoulder and arm, the duration of which was three years. The onset followed a fall. The arm ached and felt heavy. There were times when the fingers would tingle and feel numb, especially the thumb, forefinger and middle finger. The strength of gripping power in the left hand was definitely impaired. Maintained pressure against the scalenus anticus muscle about 1 inch above the clavicle increased the pain. Oscillometric readings recording the maximum pulsation, were as follows:

	Left	Right
Brachial artery	3.5°	7°
Radial artery	1.5°	5°

Thermocouple readings showed a 3°F. decrease in skin surface temperature of the left hand as compared to the right hand.

Repeated infiltrations of the scalenus anticus muscle with procaine solution (2 cc.) always gave immediate and complete relief of the symptoms. However, when the anesthesia wore off, the pain returned. Surgical section of the muscle was followed by relief of pain. There was no recurrence of symptoms.

IRRITATION OF THE BRACHIAL PLEXUS

In several patients we were able to demonstrate areas of segmental nerve tenderness which were associated with pain. These findings were combined with symptoms denoting compression of the brachial artery. Tenderness of the fourth, fifth and sixth cervical nerve distributions could be defined. Irritation of the fourth cervical nerve produces pain over the upper half of the scapular region, and in the anterior chest wall down as far as the fourth rib.

With involvement of the fifth cervical distribution, pain and tenderness were limited to the middle third of the upper arm.

The sixth cervical dermatome when affected produces pain down the arm to and including the thumb.

One patient, a twenty-six year old male, complained of severe pain in the upper anterior chest and upper scapular region. He also complained that his entire arm felt like a dead weight. The power of his grip was affected on the painful side. Pressure against the scalenus muscle increased the pain as well as the heavy sensation in his arm. A complete segment of tenderness was mapped out, covering the shoulder girdle and upper left chest. This is the distribution of the fourth cervical dermatome.

A diagnostic infiltration of 2 cc. of procaine into the muscle caused complete cessation of all pain within three minutes. The heavy sensation in the arm disappeared, and the gripping power of the hand was restored. The tenderness of the fourth cervical segment disappeared.

IRRITATION OF THE SUBCLAVIAN VEIN

The subclavian vein is not often affected by a tightened scalenus muscle. However, it may be caused by the muscle elevating the first rib and producing a partial compression of the vein, by narrowing the costoclavicular space, or perhaps by pressure on an anomalous subclavian vein passing behind the scalene muscle. We have seen two such cases, confirmed by operative findings in which the subclavian vein was found to be dilated to one and one-half times its normal diameter on the lateral side of the first rib.

The symptoms of which these patients complained were much alike. Both had a neuralgic ache of the arm extending to all the fingers. One had an area of extreme soreness over the dorsal aspect of the wrist, which was sensitive to light pressure and was associated with a burning sensation. The other patient had a similar area involving the entire base of the thumb. Both patients complained of a sensation of fullness in the fingers and "felt as though their nails were being pulled."

Objectively there was a mild dilatation of veins. The fingers were thickened and there was enlargement and tenderness of the phalangeal joints, presenting a picture of arthritic changes. The grip was weak, and the fist could not be completely closed.

In both cases the *skin surface temperature was increased on the painful side.* Oscillometric readings were normal. Infiltration of the scalenus muscle gave immediate but temporary relief of the severe pain, but did not affect the hyperalgesic areas, nor did it improve the strength of the hand clasp.

The duration of symptoms was two years in one case and fifteen years in the other.

Relief of pain followed cutting of the muscles. However, weakness of the grip and persistence of the sore spots in the periphery did not clear up immediately.

In the case of two years' duration of pain it was three months before the patient wrote and stated that his hand was beginning to get back to normal.

The patient who had had her symptoms for fifteen years also obtained nearly complete relief of pain. A year later she stated that her arm and hand had not felt so

well in the entire fifteen-year period. Neither patient developed any acute symptoms following section of the muscle.

Both patients presented signs which could be interpreted as due to arthritic processes associated with neuralgic pain. These signs were undoubtedly due to passive congestion produced by compression of the subclavian vein over a long period of time. In spite of the marked improvement of symptoms in both patients, the fingers did not regain their normal appearance.

IRRITATION OF THE SYMPATHETIC NERVES

There was one patient in our series in whom pain and vasomotor instability of the upper extremities apparently were due to irritation of the sympathetic fibers by a spastic scalenus muscle.

A forty-six year old female had excruciating pain in the left shoulder, arm and hand for a period of three weeks. The thumb and forefinger felt numb and tingled. No anesthesia or hypesthesia was present.

Although this complaint was of three weeks' duration, there was a history dating back fifteen years, in which frequent attacks of vascular spasm, at least one or two a day, caused blanching of the fingers of both hands. She stated that her fingers became "snow white" during these attacks.

Palpation revealed marked tenderness and rigidity of both scalene muscles. Slight pressure against the muscle on the left side intensified the pain. Infiltration of the muscle with 2 cc. of 2 per cent procaine gave complete relief of pain in two minutes.

Two days later, while we were about to repeat the infiltration on the left side, the right middle finger started to blanch. In one minute the distal half of the finger was completely blanched. The right scalenus muscle was injected with procaine. In about two minutes the blanched area began to disappear slowly and at the end of four minutes its normal color was entirely restored. She stated that this was the first time that such an attack had lasted less than forty-five minutes. She also stated that it was the first time that the left fingers had failed to blanch, and that they had not done so since the scalenus injection two days ago. There was no recurrence of the pain on the left side reported at the end of one month, and blanching of the fingers had considerably diminished.

Thus it will be seen that there is no distinct syndrome due to a tightened hypertrophied or otherwise irritated scalenus muscle. The symptoms are variable and depend upon which anatomical structures are affected. Although in our series of seventy-five cases most of the patients showed symptoms suggestive of arterial compression, there were many patients whose symptoms did not fit into the picture of scalenus anticus syndrome as it is commonly presented.

DIAGNOSTIC SIGNS

A reliable sign is the comparison of pressure effects upon the scalenus muscle of the non-painful side with that of the painful side. The head should be held backward and tilted away from the painful side so that palpation of the scalenus muscle will be facilitated. At the same time, the thumb, placed about an inch above the clavicle, forces the posterior border of the sternocleidomastoid muscle medially. Pressure upon the scalenus muscle of the non-painful side should be firm and maintained for a full minute. Comparison with the painful side is then made. In all cases, the tenderness is much greater on the affected side and the continued pressure intensifies the pain and distress.

A definite reduction of the oscillometric readings denotes marked compression of the subclavian artery. However, we believe that there may be mild compression of the subclavian artery which produces pain with no change is oscillometric readings. In our series a reduction of skin surface temperature of the hand and fingers accompanied a decreased oscillometric reading.

Forcing the head back and away from the affected side tightens the scalenus muscle and increases the pain.

Diminution of the power of the hand grip on the affected side is often found.

A diagnostic procaine infiltration of the scalenus anticus muscle is the most dependable indication of the presence or absence of this syndrome.

One problem is to explain why patients who present symptoms suggesting a scalenus anticus syndrome and who obtain relief by a diagnostic infiltration of procaine, fail to obtain relief of pain when the muscle is sectioned.

In reporting the diagnostic procaine test, some observers state that a Horner's syndrome frequently follows the injection. Although it is true that through the scalenus mechanism there may be irritation of the sympathetics, it is a secondary effect and infiltration of the muscle with procaine which results in a Horner's syndrome with relief of pain should not be considered evidence that the muscle is at fault. Anesthesia of the brachial plexus or its branches will also cause relief of pain even though the scalenus muscle is not at fault.

We believe the answer to this is an accurate technic of injection. One reason that a Horner's syndrome often accompanies infiltration of this muscle is that too great a quantity of procaine has been injected, so that the procaine does not remain limited to the confines of the muscle. Another is that the needle pierces the scalenus muscle or misses it entirely so that not only may the procaine affect the sympathetic chain, but it may cause peripheral anesthesia due to contact with branches of the brachial plexus.

We wish to stress that sympathetic or brachial plexus anesthesia will relieve pain whether or not a true scalenus anticus syndrome is present. Sympathetic or brachial plexus anesthesia does not take place when the procaine is limited to the muscle, nor does it occur after surgical section of the muscle.

Therefore, when a diagnostic infiltration of the muscle is followed by a Horner's syndrome, or by numbness in the shoulder, arm, or hand, the test should be disregarded and repeated on another occasion.

TECHNIC OF INFILTRATION

Previously, we reported a technic of infiltrating the anterior scalenus muscle by means of a small hypodermic needle. The technic has been simplified to make certain that the procaine will be injected into and remain confined within the muscle.

The patient's head is brought over to a painful side to relax the sternocleidomastoid muscle. Just above the clavicle, the sternocleidomastoid muscle is pushed medially, at the same time forcing the fingers inward and downward. At this moment the head is pressed to the opposite side and retracted. This causes the scalenus muscle, which at this level is just behind the posterior border of the sternocleidomastoid muscle, to become palpable so that it may be straddled by two fingers. After locating and straddling the muscle the fingers are pushed down firmly causing the muscle to bulge between the fingers. A ⅜ inch hypo-needle is inserted between the fingers, directly into the belly of the muscle, 2 cc. of 2 per cent procaine are injected.

RESULTS FOLLOWING INFILTRATION

Complete relief of excruciating pain may take place within one minute following the injection. If no relief is obtained within three minutes, we regard the test as negative.

If the patient obtains immediate relief of pain under the conditions specified, and the pain returns in a half hour or more, it is still regarded as a positive test. Fifty per cent of patients with a scalenus anticus syndrome will obtain clinical relief of pain by repeated infiltration. This is a higher percentage than we had reported previously.

If three or four successive injections cause immediate relief indicating a positive test, and on each occasion the pain returns with its former severity, the muscle should be surgically sectioned.

Patients who show continued improvement with successive infiltrations should continue with this therapy. If progress becomes stationary and the amount of residual pain warrants it, the muscle should be cut.

SUMMARY

1. Symptoms and clinical signs have been discussed which are dependent upon disturbances of anatomical structures in the vicinity of the scalenus anticus muscle.

2. A new technic of infiltration of the scalenus anticus muscle has been presented.

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Dry gangrene occurs when the tissues are desiccated by gradual slowing of the blood-stream, and typically occurs as a result of arterial degeneration. The affected part becomes dry and wrinkled, discoloured from disintegration of haemoglobin, and greasy to the touch.

Case Reports

PRIMARY ADENOCARCINOMA OF THE JEJUNUM WITH INTUSSUSCEPTION*

CASE REPORT

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CARCINOMA of the jejunum, like carcinoma of the remainder of the small intestine while not a rare lesion is infrequently seen. An acute mechanical obstruction caused by an intussusception is uncommon since this complication of small intestinal tumors is most often encountered in benign lesions, its incidence from statistical reports being placed at 17 to 30 per cent; the frequency of intussusception in malignant tumors of the small intestine is given as less than 4 per cent.

The occurrence of a carcinoma of the jejunum in one of the youngest patients recorded in the literature of the past ten years complicated by intussusception makes this case interesting.

CASE REPORT

I. S., a white male, aged twenty-four, was admitted to the Cook County Hospital December 28, 1940, (surgical service of Dr. John B. O'Donoghue) with complaints of severe, intermittent abdominal pain of four days' duration. From the history it was learned that he had experienced attacks of abdominal pain during the past two years coming on irregularly at intervals of two to four weeks. These attacks would be present for several hours and then spontaneously leave. He had noted during the preceding three months that both the frequency and intensity of these attacks had increased. The pain was described as being sharp, cramp-like, located mainly in the umbilical and epigastric regions of the abdomen and would radiate to the back. At times the pain was of such severity that the patient would roll on the floor in agony. Nausea was present and the patient would induce vomiting for relief. He had undergone an appendectomy three years previously. One year following his operation the patient was hospitalized for ten days, the diagnosis of an incomplete mechanical intestinal obstruction being made. A selective dyspepsia to cabbage, fatty and fried foods was present.

On admission the temperature was 99.6°F. rectally, the pulse rate 110, respirations 28 and the blood pressure 124 systolic and 80 diastolic. The essential physical-pathological changes were limited to the abdomen and consisted of moderate distention and tenderness on palpation over the right upper and lower abdominal quadrants. On auscultation, the peristaltic sounds were markedly diminished and metallic tinkles with an occasional rush were heard. Examination of the urine gave negative results, the leukocyte count numbered 9,500 cells per cubic millimeter.

The patient was treated conservatively with Wangensteen suction, parenteral fluids, mineral oil by mouth and repeated tap water enemas. No improvement of the clinical symptoms was observed during the following day and since the

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auscultatory findings of the abdomen were indicative of progressive obstruction it was the opinion that a mechanical type of obstruction of the small intestine was present and surgical intervention advised.

Operation was performed by one of us (M. E. L.) on the day following admission to the hospital. Under spinal metycaine anesthesia the abdomen was opened through a right paramedian epigastric incision. The intestinal loops of the upper jejunum were markedly distended; the lower loops collapsed. A considerable amount of serous fluid was present in the peritoneal cavity. Two inches distal to the ligament

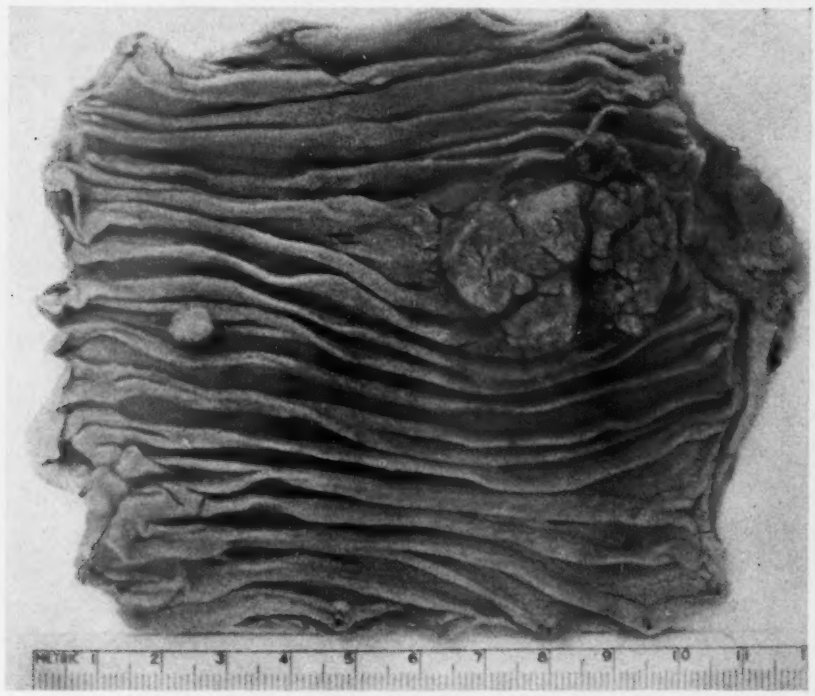

Fig. 1. Photograph of resected portion of jejunum showing a mucus producing adenocarcinoma and adjacent, a jejunal polyp.

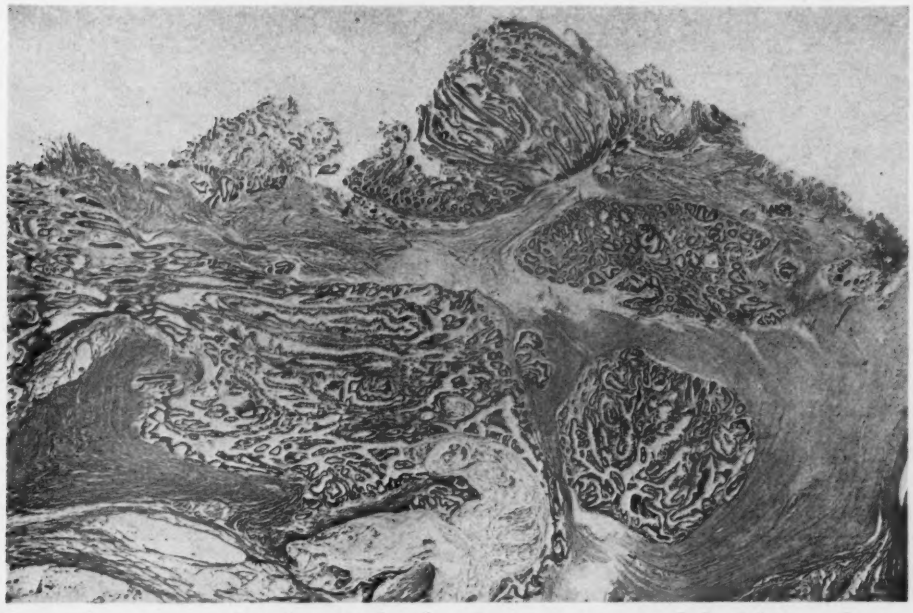

Fig. 2. Low power microphotograph taken from tumor area of the jejunum (hemotoxylin-eosin stain × 17.5).

of Treitz a jejunojejunal intussusception was present. This was reduced with ease; however, at this site a firm, constricting, infiltrating mass was present. In addition several polypi were palpable. No enlargement of the lymph nodes in the mesentery were palpable, therefore, a wide resection of this area together with its mesentery was performed. The continuity of the intestinal tract was restored by an end-to-end entero-anastomosis.

Fig. 3. High power microphotograph taken from tumor area showing invasion of the muscularis propria (hemotoxylin-eosin stain × 64).

The resected specimen was submitted to the Department of Surgical Pathology and was described as follows:

"Grossly, the specimen consists of a segment of the jejunum measuring 9.5 cm. in length and 10.5 cm. in circumference. The serosa is a light purplish gray in color. At a point 1.5 cm. from the mesenteric attachment on its lateral aspect the serosa is wrinkled and puckered and is a darker reddish gray and is adherent to the underlying structures. At this site on its mucosal surface it is deformed by a pedunculated papillary mass measuring 3.5 × 3 × 1.5 cm. The free surface is cauliflower-like in character, purplish red in color, firm and infiltrates the underlying submucous membrane. On the opposite side of the mass is a pedunculated polypoid structure measuring 4 × 3 × 3 mm. attached to the mucous membrane by a short broad pedicle 3 × 1 mm. in diameter. The mucosal folds are distinct light purplish gray in color.

"Microscopically, sections taken reveal a mucus producing papillary adenocarcinoma of the jejunum."

The postoperative course was entirely uneventful, multiple blood transfusions, parenteral fluids, intravenous cevitamic acid together with general supportive measures resulted in his being afebrile on the fourth postoperative day. On his fifteenth postoperative day the patient was discharged from the hospital. He has since

remained well and has had no symptoms referable to the gastrointestinal tract. (Figs. 1 to 5.)

of the small intestine from the various clinics. Ewing[1] states that carcinoma of the small bowel forms 3 per cent of all intestinal

FIG. 4.

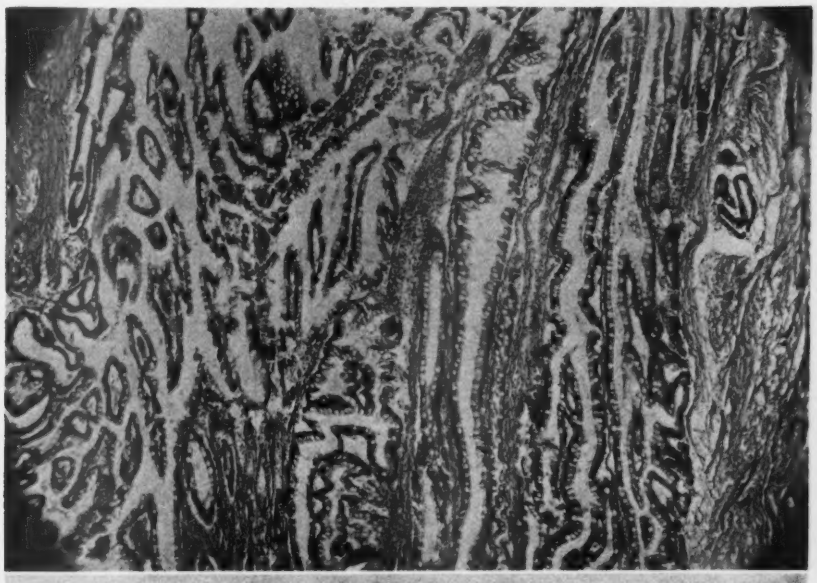

FIG. 5.

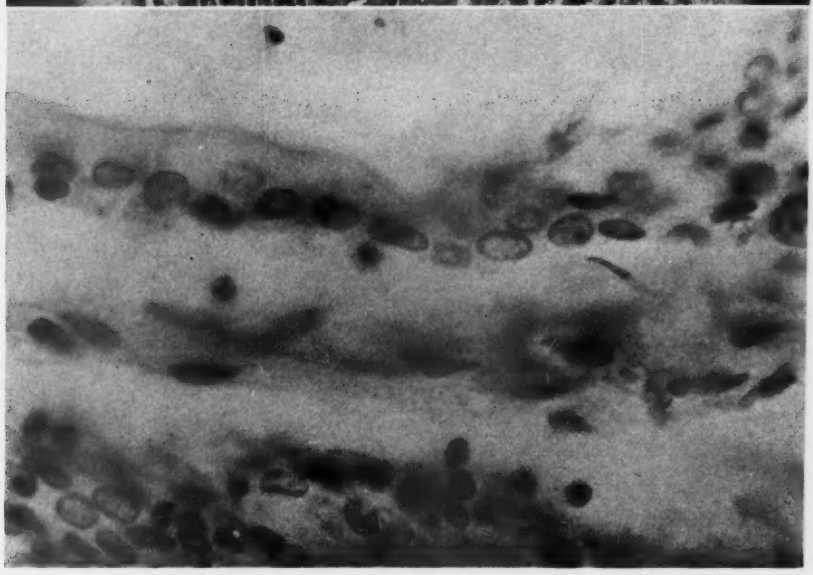

FIG. 4. High power microphotograph taken from tumor area showing mucus producing cells lining the intestinal crypts (hemotoxylin-eosin stain × 64).

FIG. 5. High power microphotograph taken from tumor area of the jejunum showing the marked anaplasia with an occasional mitotic figure (hemotoxylin-eosin stain × 1280).

COMMENTS

From the statistical study given in Table 1 it will be seen that carcinoma of the small bowel is relatively uncommon and occurs with least frequency in the jejunum. Because of this rarity there is some discrepancy in the reported incidence of carcinoma

carcinomas. Mayo and Nattrour[2] in reviewing seventy-six cases of carcinoma of the small intestine observed at the Mayo clinic in the ten years prior to 1936 found that carcinoma of the small bowel comprised 0.62 per cent of all the carcinomas from the cardiac end of the stomach down to and including the rectum and that carcinoma of

the jejunum formed only 0.15 per cent of all the carcinomas of the gastrointestinal tract.

A review of 16,318 consecutive necropsies performed at the Cook County Hospital during the fourteen years from 1929 to 1943 revealed only seven cases of carcinoma of the small intestine. Three were in the duodenum and four in the jejunum.

region chiefly in infancy and once reduced, rarely recurs. Gross causative disease is seldom found.

Many theories have been advanced to explain the cause of primary intussusception, e.g., excessive lymphoid tissue in the terminal ileum (Perrin and Lindsay);[5] mobile cecum (Leriche and Cavaillon);[6] in-

TABLE I

AUTOPSY STATISTICS

Years	Source	No. of Autopsies	Carcinoma of				
			Small Intestine	Jejunum	Ileum	Duodenum	Undetermined Site
1870–1893	Vienna General Hospital*	41,838	17	0	10	7	0
1886–1891	Pathologic Institute of Berne*	5,621	9	0	3	6	0
	Zeman*	21,624	9	0	6	3	0
To –1932	Johns Hopkins Hospital[13]	11,500	16	4	3	7	2
1929–1942	Cook County Hospital	16,318	7	4	0	3	0
	Total	96,901	58	8	22	26	2

* Cited by Hermann Nothnagel (Diseases of the Intestines and Peritoneum, in Nothnagel's Encyclopedia of Practical Medicine, Philadelphia, W. B. Saunders Company, 1904, vol. 8, pp. 402–404).

The relative infrequency of carcinoma of the small intestine has given rise to many theories, among which may be mentioned the embryonic rest theory of Cohnheim. Other authors have attributed the low incidence to the absence of abrupt bends and irritation as is seen in the sigmoid colon and rectum. Carcinoma of the intestinal tract is found at points where there is an abrupt change of the lining epithelium of the canal, e.g., at the junction of the esophagus and the stomach or at the anus and rectum. Rankin and Mayo[3] subscribe to the theory that the fluid nature and the alkaline reaction of the contents of the small intestine may explain the lowered incidence of carcinoma of the small bowel.

In an excellent discussion of intussusception due to intestinal tumors, Fiske[4] distinguishes the primary and the secondary group from its causative factor, or an acute, chronic or recurrent group from its clinical picture. The primary group usually has an acute onset, occurs at the ileocecal

co-ordination of the autonomic system at the ileocecal region where the dual sympathetic and parasympathetic supply of the ileum gives way to the single sympathetic control of the large bowl. (Fraser.)[7]

The secondary group usually has a chronic or recurrent onset, occurs in older children and adults and tends to recur if the causative disturbance is not removed. Intestinal tumors, benign and malignant, intestinal ulcers due to typhoid, dysentery and tuberculosis and Meckel's diverticula are the most common underlying lesions. Benign tumors are more frequently the cause of intussusception than malignant tumors. Rankin and Newell[8] found that intussusception occurred in 17 per cent of a series of thirty-five cases of benign tumors of the small intestine, while in a series of fifty-five cases of carcinoma of the small intestine reported by Rankin and Mayo[3] intussusception was encountered in only two cases (3.6 per cent).

Medinger[9] is of the opinion that malignant tumors of the jejunum and ileum are prone to produce intussusception. This is concurred with by Brown and McHardy,[10] (while Carter,[11] Fiske[4] and Joyce[12] disagree. Raiford,[13] in reporting eighty-eight cases of tumors of the small intestine in a series of 11,500 autopsies and 45,000 surgical specimens found that fifty were benign and thirty-eight malignant. The jejunum was involved in fourteen instances, five cases being malignant the remaining nine benign. In Raiford's series, intussusception occurred in 23 per cent of the cases, the large majority being caused by benign tumors.

In summarizing the clinical symptoms presented in a series of seventy-six cases of carcinoma of the small intestine, Mayo and Nattrour found that in about 80 per cent of their cases a typical clinical history of a lesion of the small intestine was obtainable. Cramps and epigastric discomfort are the most common chief symptoms. Usually there is a history of recurrent short episodes of intestinal obstruction, associated with cramps, nausea and vomiting. These symptoms occur for three or four months and tend to become more frequent and more severe. Gas, rumbling and bloating are common symptoms.

A secondary anemia of the microcytic hypochromic type is generally the case. Plunkett[14] and his co-workers have recently pointed out that the anemia may result from the occult bleeding and the interference with the absorptive function of the small intestine.

While the average age in cases of carcinoma of the jejunum was found by Rankin and Mayo to be 47.5 years, this was later revised by Mayo and Nattrour to 51 years, the youngest patient in their series being thirty-two years of age. In Raiford's series of eighty-eight cases of the small intestine the youngest patient with carcinoma was thirty-three years of age. Joyce reported a case of carcinoma of the jejunum with metastasis in a twenty-five year old Filipino. In the necropsy records of carcinoma of the jejunum from the Cook County Hospital the average age was 47.5 years; the sexes were equally divided.

SUMMARY

A case report of a mucus producing adenocarcinoma of the jejunum with intussusception in a white male, aged twenty-four, is presented.

In a review of 16,318 necropsies performed at the Cook County Hospital four cases of primary carcinoma of the jejunum were found.

From a review of the literature carcinoma of the jejunum is infrequently seen, having an incidence of 0.9 to 0.15 per cent among all the carcinomas of the gastrointestinal tract.

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BILATERAL RENAL LITHIASIS*

CASE REPORT

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THE study and treatment of renal lithiasis has advanced more in the past decade than in all of the preceding centuries. The diagnosis and interpretation of pyelograms in stones of the urinary tract has been so perfected that only the rare case will be missed in the course of a complete urological survey. Differential diagnosis between calcified abdominal glands, calcification in intestinal viscera and gallbladder stones may at times be difficult. The reporting of the rare and unusual case keeps our minds alive to these various possibilities when subjective symptoms are vague and urological studies are suggestive. In the non-opaque calculus of the urinary tract, aids such as the wax-tipped catheter and the filling defect in the urogram or the injection of a non-opaque substance that will cling to the stone, usually reveals the true diagnosis. Lateral urograms are necessary where there is a question as to whether or not we are dealing with stones in the kidney or in the gallbladder. Careful study will usually reveal very accurately the correct diagnosis but often the interpretation of urograms may be very misleading and the careful reporting of unusual cases is doubly important in the future reading of similar entities.

The treatment of urolithiasis, while fairly well standardized, calls very often for the best type of individual managerial judgment. What to do, how and when, will often depend upon the judgment and experience of the clinician, aided not only by the interpretation of the anatomical findings but by the sense of values which he may have of the physiological abilities of the anatomically distorted organs to perform their normal functions.

The following case is reported because there are so many lessons to be learned from it and because a careful study of all of the factors involved in the diagnosis and treatment of this case add much to our knowledge and experience in the future management of certain types of urinary lithiasis. Seldom does a case carry with it so much that may be applied to many cases.

CASE REPORT

S. M., age forty-four, a white male, was admitted to the Clinic on November 12, 1942; file no. 134404.

The patient had no chief complaint. The history of his present illness showed that several weeks before he was apparently in good health and had applied for life insurance. Upon examination of his urine, an unusually large number of white blood cells and some albumin were found and he was requested to have this checked for some possible urinary tract infection before he was given his insurance. He had no subjective symptoms referable to the urinary tract or to any part of his body. He never had been sick in his life. He had worked as a plumber ever since he was a young man, in all sorts of weather and under all sorts of conditions. He had never had an ache or pain. He was not subject to colds or sore throats. There had been no burning or frequency of urination. He denied all venereal infection. As a result of this insurance examination, he reported to the Clinic for a complete urological survey, principally at the request of his brother-in-law who is a physician.

His past medical history was essentially negative. His physical findings were normal throughout in every particular for a man of his

* From the Department of Urology, St. Vincent's Hospital, Erie, Pa.

age: Blood pressure 130/80; temperature 98.6°F., pulse 74; respirations 18.

On November 12th, his urine was yellowish cloudy; specific gravity 1010; hydrogen ion concentration 7.5; 150 mg. albumin. Microscopically, there were many white blood cells. Blood urea nitrogen was 18.2; blood sugar 94; Wassermann and Kahn tests negative.

The cystoscopic examination showed no obstruction to the scope; there was normal bladder capacity. The bladder was filled with a thick tenacious mucopus, making it difficult to wash the bladder sufficiently clear to find the ureters. Both ureters were dilated but apparently not inflamed. Catheters were passed to both kidneys and urine dripped from the right but none from the left. The indigo-carmine test was normal from the right kidney, none from the left.

FIG. 1. Plain film showing a right renal staghorn calculus 18 by 10 by 10 cm., a calculus in the left renal pelvis and one in the upper portion of the left ureter.

The plain urogram showed a huge staghorn calculus filling the right pelvis and calyces. On the left side, there was a large 2.5 cm.

calculus opposite the second lumbar body and an oval one opposite the third lumbar. (Fig. 1.)

was seen about the lower calculus. A small amount of dye was seen in the bladder at thirty and sixty minutes. (Fig. 2.)

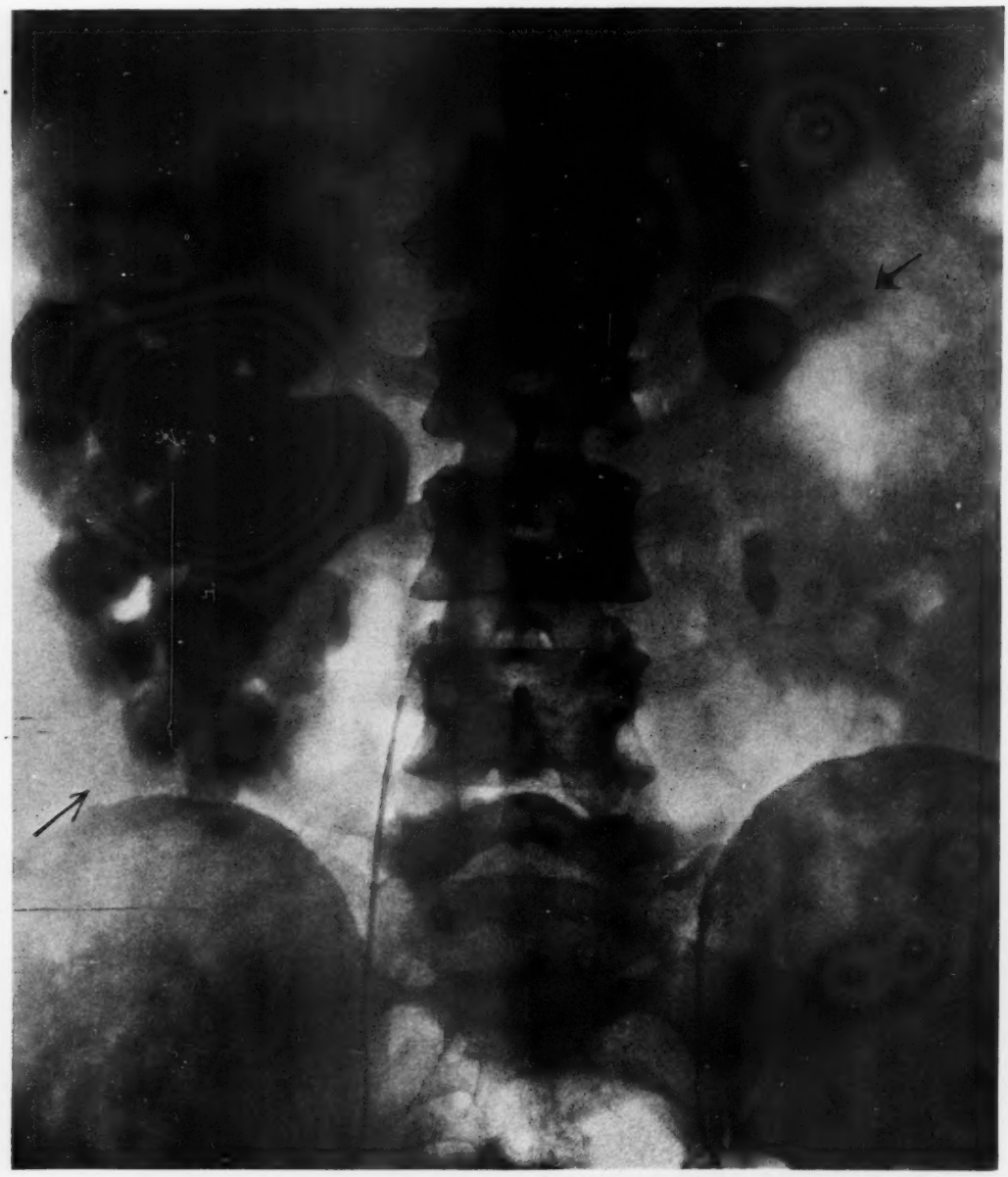

FIG. 2. Thirty minute intravenous pyelogram which shows some secreting renal parenchyma and an intensified shadow of the staghorn calculus on the right side. The arrow points to a single calyx which was functioning in the left kidney, although at operation we had hoped we were dealing with an hydronephrosis on this side. The left kidney was completely destroyed with the exception of the pyramid draining into the single calyx; and life, with a normal blood urea balance, was maintained by the parenchyma that was left on the side of the large staghorn calculus.

A retrograde pyelogram was not attempted because of the obvious damage to both kidneys and following is the report of the intravenous injection.

Ten and thirty minutes after intravenous administration of diodrast, a faint pyelogram was seen about the upper left stone. No dye

No tubercle bacilli were found in the urine. The organism cultured was a hemolytic staphylococcus aureus. Red blood cells 4,600,000; white blood cells 8,600; hemoglobin 94 per cent; polymorphonuclears 72 per cent; s. lymphocytes 21 per cent; monocytes 5 per cent; eosinophiles 2 per cent.

The patient was voiding over a twenty-four hour period approximately the same amount of fluid that he was ingesting. After studying waiting for that kidney to recover. After the patient had recovered from this procedure, it was hoped that it might then be possible to

Fig. 3. This is a lateral view of the bilateral renal calculi and shows the excessive size of the calculus in the right kidney, and also shows the single calculus in the left pelvis and the one in the left ureter.

the pyelograms carefully, it was hoped that the stone in the left ureter was blocking a calculous hydronephrosis on the left side. The left kidney was operated upon first. This was done with the thought in mind of doing a nephrostomy on this side, removing the stone in the ureter and the stone in the pelvis and remove either the large staghorn calculus in the right kidney, or to remove the right kidney completely.

A left nephrectomy was done on November 16, 1942 The incision was made in the skin over the twelfth rib. The rib was removed, transversalis fascia and Gerota's fascia were

opened. A small atrophic kidney bound down with adhesions was found. It was thought best to remove same. The ureter was clamped and ligated and the pedicle was also clamped and ligated. Two cigarette drains were placed in the wound. The muscles were closed in layers with interrupted catgut and the skin was closed with clips.

The left kidney was found to be small, atrophic with a thickened capsule about one-quarter of the normal size, one large stone in the renal pelvis and a large oblong stone in the upper third of the ureter completely blocking same.

A not too unexpected atrophic kidney was found. The patient made an unusually nice recovery from the nephrectomy, which was considered necessary, voided urine normally immediately after the operation and continued to void normally and had no postoperative shock or distress of any kind. He was discharged on November 29th, with a normal temperature of 98.4°F., pulse 80, respirations 20. His wound was completely healed. The urinalysis at this time was: Appearance, yellow cloudy; specific gravity 1007; hydrogen ion concentration 7.5; 75 mg. albumin, very few white blood cells in the urine and many red blood cells.

The patient had no pain on his right side. He was given the choice of having another operation to remove the huge staghorn calculus and to drain the kidney or to let things ride as they were. He elected for the time being to forego any further surgery.

Pathological Report: Tissue: Left kidney.

The gross examination showed the specimen to consist of a small atrophic kidney, a thickened capsule, and about 6.5 cm. of ureter. A stone could be palpated in the ureter and also in the pelvis of the kidney. The capsule was stripped with great difficulty and left a surface which was granular and irregular in appearance. On section, very little if any normal appearing kidney tissue was seen. The calices were dilated and filled with straw-colored material. Both the cortical and the medullary regions showed an increased amount of adipose tissue. The pelvis was dilated and contained one stone. This measured 2 by 1.5 by 1.5 cm. The mucosa of the pelvis showed hyperemia and a few small pinpoint areas of hemorrhage. About 2.5 cm. from the junction of the ureter and the kidney, there was another stone present in the ureter which was oblong in shape and which measured 2 cm. in length and 5 mm. in diameter. Both of these stones were tannish-brown in color. The one in the kidney pelvis was smooth externally, whereas the one in the ureter was irregular and roughened. The ureter was not dilated except at the point where the stone was lodged.

Microscopically a few glomeruli were present. All of these showed thickening of Bowman's capsule and sclerosis of the glomerular tufts. Other hyalinized glomeruli were also seen. The remnants of a few tubules were observed. These did not appear to be of much value from a functional standpoint. Many of them were filled with pink, homogeneous staining material and others showed beginning destruction of their epithelial linings. All of the sections showed a marked amount of hyalinized connective tissue in which lymphocytes were found. All of the blood vessels including both the small ones and the large ones, showed a marked amount of sclerosis.

Diagnosis: Chronic pyelonephritis; chronic ureteritis; hydronephrosis; renal and ureteral calculi.

COMMENT

This is a very unusual case of bilateral renal lithiasis as the plain film and intravenous pyelograms will show. The staghorn calculus in the right kidney measures 18 by 10 by 10 cm. There is also a large pelvic stone in the left kidney with another one in the upper third of the left ureter. Had we interpreted the intravenous urograms correctly, together with our cystoscopic findings, we might have known that there was an atrophic kidney with one small functioning pyramid. However, we hardly believed that the right kidney, containing the huge staghorn calculus, had enough functioning parenchyma to sustain life and hoped that we were dealing with an hydronephrotic organ on the left side, which could be relieved by removing the stone in the ureter and pelvis, and thought that there might be enough renal parenchyma here to carry the patient while some operative procedure was attempted on the right kidney.

The fact that the patient was symptomless made us believe that the attack on the

left kidney should be done first and when we found the small atrophic kidney upon operation, there was nothing left to do but remove it.

The situation was then carefully explained to the patient and he was told that the right kidney apparently was functioning sufficiently to maintain normal blood urea balance and to sustain life and that surgery might be attempted on the remaining kidney, with the thought in mind that the remaining renal parenchyma would last longer if we were able to remove the large staghorn calculus successfully. All of the dangers of infection and further injury to the small remaining renal parenchyma as a result of infection, et cetera, were carefully explained to him and, of course, the mortality and morbidity possibilities in the event of surgical failure to remove the calculus completely. We believed that the decision for further surgery, after careful explanation, should be left to the patient's discretion.

Nephrectomy, of course, would have been indicated on the right side if the patient had possessed a nearly normal left organ.

It is interesting to note that the blood pressure in this particular case is perfectly normal. The patient is still alive and comfortable six months after the left nephrectomy from which he recovered very promptly and with an uneventful convalescence. He is working as a plumber every day and is apparently in good health and free from symptoms.

This is the largest staghorn calculus I have ever seen and the case is particularly interesting because of the fact that the renal parenchyma on this side has sustained life for a long period of time and is still capable of maintaining normal blood chemistry balances.

ACUTE HEMORRHAGIC PANCREATITIS*

A NEW ETIOLOGICAL CONCEPT AND CASE REPORT

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THERE is one disease in surgery which is an unsolved problem from many aspects. The mortality is high, the pathology not entirely understood, the diagnosis infrequently made, and the etiology remains within the realm of speculation.

The factors producing acute hemorrhagic pancreatitis as well as its exact cause are unknown. The classical concepts of the pathogenesis of this disease were promulgated by Wangensteen in 1931, and by Dragstedt in 1934. The latter concluded that 60 per cent could be explained on the old common channel theory, 10 per cent of these being caused by stone in the ampulla and the remainder by spasm or edema of Oddi's sphincter as reported by Archibald.

In general, McWhorter's classification on an etiological basis is as useful as any other system. Accordingly there are three major origins of this disease: (1) Infectious origin; (2) non-infectious origin, and (3) combinations of two or more factors. The infectious group includes all avenues of bacterial invasion. The non-infectious heading is subdivided into the mechanical or obstructive causes, chemical factors due to bile, the degenerative changes and traumatic pancreatitis.

Another contribution to the etiology of this disease was made by Binet (1929) when he reported his experimental work. He postulated the humoral syndrome of hemorrhagic pancreatitis. Other men as Weiner (1939) advanced the belief that alcohol in some way was related to the causation of this disease.

Within the past decade, experimental evidence has been published by European investigators and authors which lends credence to another etiological factor, namely, anaphylaxis. Smull has termed this, pancreallergy. Predisposing causes to this state of allergy has been attributed to trauma, alcohol, adiposity, arteriosclerosis, gastrointestinal disturbances, especially gastroduodenitis, chronic cholecystitis, and cholelithiasis. In most instances these states, with the exception of bilary tract disease, are considered secondary contributing causes. Those with inborn allergic sensitiveness of the pancreas or sphincter of Oddi may develop repeated attacks of pancreallergy without a predisposing factor present. In the majority of cases chronic cholecystitis and cholelithiasis with or without the associated chronic pancreatitis and the usual presence of micro-organisms are the most potent agents sensitizing the sphincter of Oddi.

In substantiating the allergic basis for pancreatitis, some authors have postulated anaphylactic shock as the cause for the disease. It is described as an anaphylactic shock of the neurovegetative system. This shock has been produced experimentally by foreign proteins or by substances which are toxic for the tissues. The French experimenters, Couvelaire and Bargeton, attempted to investigate the provocation of pancreatitis in 1933.

Experiments were carried out on six dogs. All were operated upon during the process of digestion. Gentle handling eliminated the traumatic factor. Horse serum was used as an anaphylactic substance. When sacrificed the pancreas showed slight hemorrhagic suffusions and hemorrhagic edematous congestion. The involvement of the pancreas was secondary. All the

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viscera showed multiple hemorrhages. The second animal was sensitized by an intravenous injection of 20 cc. of horse serum. After twenty-three days a laparotomy under local anesthesia was performed. Four cc. of horse serum was injected into the pancreaticoduodenal vein and 0.5 cc. directly into the glandular tissue; later the vein was ligated. Signs of generalized shock were almost completely absent. A diffuse localized persistent pancreatic edema appeared immediately. Twenty-four hours later the dog was in good condition. It was sacrificed. The autopsy revealed some serosanguineous fluid in the peritoneal cavity with many white spots of fat necrosis on the omentum. The pancreas was edematous and contained scattered multiple hemorrhages of irregular distribution. The third and fourth animals presented a similar picture following identical treatment. The fifth and sixth dogs were controls in the experiment. From these experiments the authors drew the conclusion that edematous and hemorrhagic pancreatic lesions can be produced experimentally on the basis of local anaphylaxis.

An Italian investigator, Bezza, investigated this problem in 1938. He was able to produce in dogs, with almost absolute constancy, the pathological picture of acute pancreatitis. Both macroscopic and histological pathological evidence was offered. In one hour he could produce by Arthus phenomenon an acute diffuse pancreatic edema. Later at variable hours hemorrhage would appear, as well as steatonecrosis without an inflammatory reaction.

Dr. Bezza experimented with sixteen dogs each of which received 8 cc. of normal horse serum subcutaneously for five consecutive days. In thirty-five to forty days the dogs would be sensitized as proved by means of the Ascoli precipitation test. Then by means of laparotomy, according to Brocq's technic, 5 cc. of normal horse serum was injected into the duct of Wirsung. Half of sixteen dogs were injected during the process of digestion; the others were injected while fasting. The dogs were sacrificed at different intervals of time. By this procedure of sensitivity, he produced a pathological picture in dogs which was pathologically similar to acute hemorrhagic pancreatitis of human beings.

At Kings County we have encountered a case of pancreatitis which we believe has some association with anaphylaxis. As previously mentioned the sensitizing factors are frequently chronic cholecystitis with cholelithiasis. The precipitating cause was sodium morrhuate employed in the treatment of varicose veins.

Allergic reactions following the injection of sodium morrhuate are not unknown. The mechanism in the production of allergy with this drug is not fully understood. Rosenzweig studied this problem. After studying a large series of cases, in which sodium morrhuate was used, he found very few reactions (about 12 per cent) with the first injection of the antigenic substance; the majority or 87 per cent of reactions take place during the course of treatment. Some reactions can occur as late as the twenty-third injection. Authorities are not uniform as to the cause of allergy with sclerosing solutions of sodium morrhuate. Some (Rosenzweig et al.) believe that it may be due to a protein fraction in the sclerosing substance. Other (Zimmerman and DeTakats) maintain that the allergic-like responses may be due to saponified fatty-acids themselves or to an admixture with liver proteins, or to hemolysis caused by the solution and resulting in the liberation of a protein substance.

Whatever the mechanism may be in the production of allergic manifestations with sodium morrhuate, is not pertinent here. We believe that the case presented may be demonstrable of pancreallergy, due to this drug. In this instance the diagnosis of acute hemorrhagic pancreatitis was established and confirmed by operative examination. The conclusive operative findings

were as follows: An abundant blood stained abdominal fluid was present. (Culture of this fluid demonstrated non-hemolytic streptococci and staphylococci.) The omentum, mesentery, and serosal surface of the visible abdominal organs contained innumerable small whitish yellow plaques indicating true fat necrosis. The pancreas was dark red in color and markedly enlarged. The gallbladder was distended and contained numerous multifaceted calculi.

CASE REPORT

The patient was a forty-eight year old housewife who entered Kings County hospital on November 11, 1942, with a chief complaint of generalized abdominal pain. The pain began four days before admission at which time it was sudden in onset, diffusely distributed over the abdomen, radiating to the right flank and down both legs. Later it radiated to the left shoulder and interscapular area. The initial onset of pain followed by eight to twelve hours a weekly injection for varicose veins at another hospital. The patient vomited at the onset of the pain. Vomiting was always preceded by nausea. As the pain increased in severity, the patient's abdomen became distended. She was admitted finally to Kings County hospital. At the time of admission, the fourth day of her illness, she had not had a bowel movement in forty-eight hours. The only nourishment in three days was a little tea and ginger ale.

For three weeks prior to her hospitalization, the patient received weekly injections of 1½ to 2 cc. of sodium morrhuate for bilateral varicose veins. Four months before she had an attack similar to this present illness, not known whether preceded by any injection therapy. However, this former illness was transitory, lasting three days and much milder in intensity. Ten years ago she was told that she had kidney trouble. There was no history of accidental injuries or operations.

Physical examination on admission revealed a well developed, well nourished, white, obese female, forty-eight years of age in acute distress and shock. Blood pressure was 90/60, pulse 120, fair quality and tension, temperature 102.2°F., respirations were 38, rapid and shallow; slight dyspnea was noted. Examination of the head and neck revealed nothing unusual. Heart sounds were distant with a questionable mitral systolic murmur. Respirations were rapid and shallow. There was no alteration of percussion sounds but bilateral basal moist râles posteriorly were heard. The abdomen was distended, tender throughout with a point of maximum tenderness in right upper quadrant but not tympanitic. There was moderate tenderness in the right costovertebral area and peristalsis was audible. The only significant finding in the rectum was a soft bulging mass of the right rectal wall. The extremities showed marked bilateral varicose veins; some were indurated.

Laboratory data on admission to the medical service were as follows: White blood cells 12,800 with 80 per cent polymorphonuclears; red blood cells 3,810,000; hemoglobin 65 per cent; urinalysis revealed positive albumin. Impression: Perforated acute gallbladder or peptic ulcer.

Three hours after admission the patient was transfered to the surgical service and again examined and found to have a diffusely rigid abdomen, most marked in the upper half of the abdomen. Marked tenderness was elicited in the right upper quadrant and to the right of the umbilicus. A mass was felt in the right upper quadrant. The mass moved easily with respiration. There was no obliteration of liver dullness. The palpable mass was believed to be gallbladder.

Following the intravenous administration of fluid and plasma it was decided to perform a laparotomy (seven hours after admission). At this time the pulse was 90 and the blood pressure 115/78.

The patient was operated upon and expired during the operative procedure as the fascia was being closed. The procedure was an exploration of the abdominal viscera, followed by cholecystostomy. The patient was under ether for fifty-four minutes at the time of death. Sulfathiazole was placed into the peritoneal cavity. Drains were inserted to the body of the pancreas and under the gallbladder.

The peritoneal cavity contained 1,500 cc. of hemorrhagic fluid. The greater omentum, mesentery, and serosal surface of the visible abdominal organs were studded with numerous areas of necrosis. The pancreas was slightly enlarged, soft in consistency, hemorrhagic in appearance, reddish brown in color. The gallbladder was distended and contained numerous multifaceted calculi.

Operative Diagnosis: (1) Acute hemorrhagic pancreatitis; (2) subacute cholecystitis with cholelithiasis.

CONCLUSION

It is not proved beyond all doubt that a direct causal relationship exists between the disease entity found at operation and the injection received by this patient. Nevertheless, in view of the experimental evidence found in the literature, this anaphylactic etiological concept should not be entirely disregarded. A thought is advanced, therefore, that in the pathogenesis of acute pancreatitis one ought to consider in association with other causes, the theory of anaphylaxis. With the postulation of this theory, it is hoped that other clinicians and experimenters will substantiate this contention with additional evidence.

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POLYPOSIS OF THE GALLBLADDER*

REPORT OF A CASE DIAGNOSED PREOPERATIVELY BY ROENTGENOLOGIC EXAMINATION

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THIS case of polyposis of the gallbladder is reported for three reasons: (1) Rarity, as shown by a paucity of reports or descriptions in the literature, (2) prophylactic importance, because of a possible predisposition of the polypoid growths to carcinoma, and (3) interest, because of the preoperative roentgen diagnosis and to stimulate further such diagnosis in these cases.

CASE REPORT

N. W., female, age fifty-two, was admitted to the Henry Ford Hospital on February 24, 1942, complaining of bleeding from the rectum, weight loss, and abdominal distress centered in the epigastric region and left lower quadrant. Bleeding from the rectum had become increasingly frequent during the past two months, with a loss in weight of ten pounds over the same period. This loss of weight was proportionately sizable as the original weight was 104 pounds. The epigastric distress had been intermittent for three months and was associated with nausea and vomiting only in the last few days. Pain in the left lower quadrant was definitely relieved by defecation.

Physical examination was essentially negative. Proctoscopic examination revealed multiple small polypoid growths in the rectal canal about and above the first rectal valve. Surgical consultation concerning the epigastric pain suggested cholecystitis, with no evidence of masses. Surgical removal of the rectal polyps revealed them to be benign. Pelvic examination demonstrated only senile mucosal changes, with senile atrophy of the uterus and adnexae.

Among the diagnostic procedures the blood count showed only slight anemia with the hemoglobin 12.5 Gm., red blood cells 4.32 million, white blood cells 4,750, and a normal differential count. Blood cephalin cholesterol was 3 plus, and fasting blood sugar 80 mg. Urinalysis showed a few leucocytes and 2 plus epithelial cells, specific gravity 1.010, and albumin and sugar negative. Examination of the stool some time after removal of the polyps in the rectum revealed no blood, no mucus, one plus bile, and was otherwise negative as was the culture. Fractional gastric analysis showed 4 plus mucus, and was negative in other respects. Transduodenal biliary drainage revealed absence of "B" bile. Gastrointestinal roentgen examination demonstrated normal serial films of the stomach. No organic defects were observed on barium studies of the colon. Cholecystograms (Fig. 1) taken February 28, 1942, showed "the gallbladder shadow well visualized in the 12 and 16 hour examination. There are a number of small negative shadows of sharp outline. These are somewhat different than the usual negative shadows due to gallstones, rather we believe that the possibility of polypi of the gallbladder will have to be considered."*

The patient was discharged at this time for follow-up treatment in the out-patient clinic mainly for psychologic reassurance because of her intense fear of "cancer growth," and to attempt to re-establish her weight. She was readmitted into the hospital on April 30, 1942, for cholecystectomy. Blood examinations at this time showed only slight increase in red blood cells to 4.59 million, hemoglobin 12.5, white blood cells 4,850. Serial bromsulfalein examinations were normal. Blood cephalin cholesterol was 4 plus. Preoperative preparation included a high protein, high carbohydrate diet.

Operation was performed in May 2, 1942, by one of us (H. N. H.) using ethylene-ether anesthesia. The abdomen was opened by transverse incision through the right rectus muscle and sheath about 3 cm. above the umbilicus. Abdominal exploration of the genitalia, stom-

* Quoted from *x*-ray diagnosis by Dr. Howard P. Doub, Chief Roentgenologist, Henry Ford Hospital.

* From the Division of General Surgery, Henry Ford Hospital, Detroit.

ach, duodenum, pancreas, intestines, common duct, and liver revealed no abnormality. The gallbladder was small and although the walls were definitely pedunculated. No stones were present and otherwise the gallbladder did not appear diseased as seen in Figure 2. The abdo-

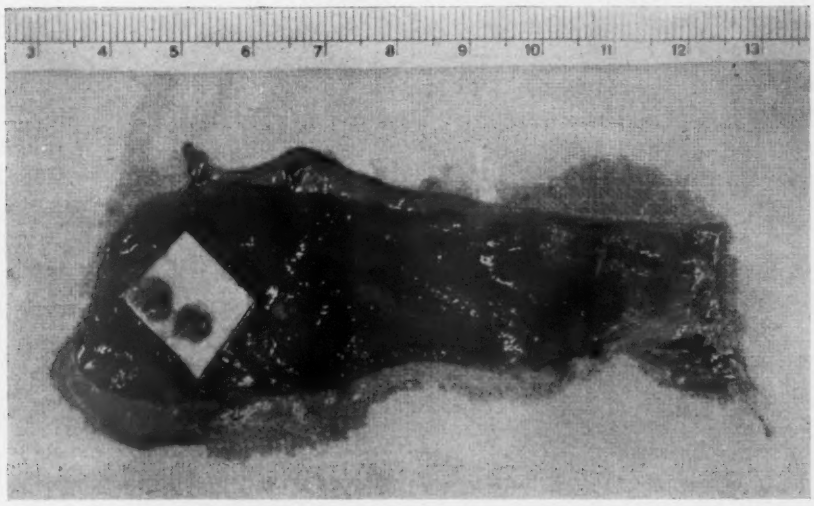
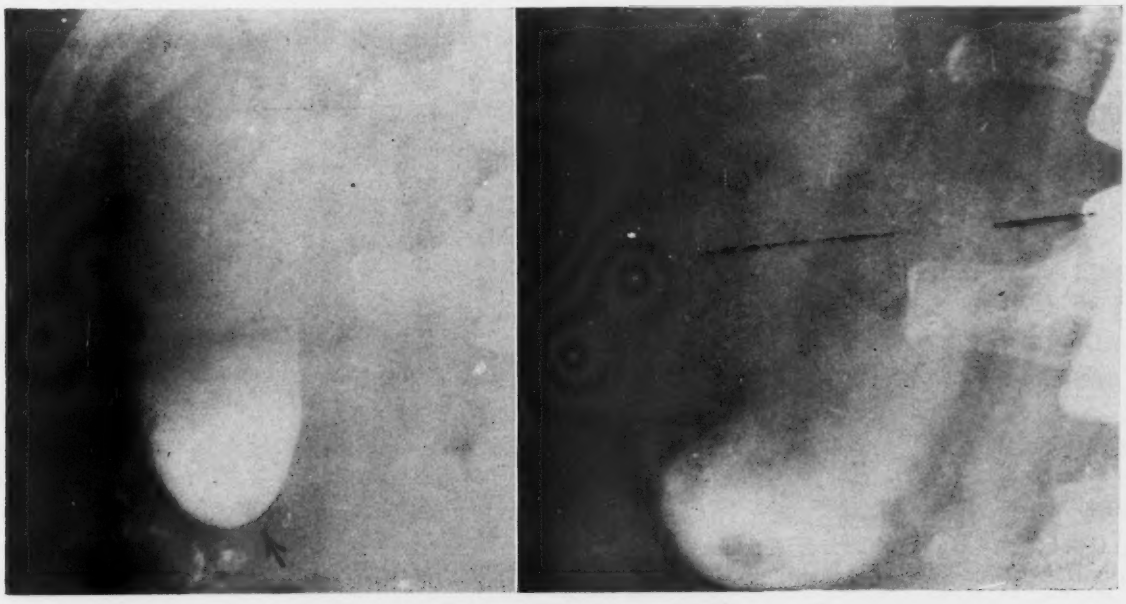


Fig. 1. Photograph of opened specimen showing two polyps of the gallbladder. The fundus is to the left, the cystic duct end to the right. The polyps are outlined against a background of paper and the dim outline around the polyps is caused by water on the paper. The very thin pedicles are clearly shown. It is difficult to recognize in this photograph the four flat papillomas which are also present.



A B

Fig. 2. Two views of the gallbladder region after dye administration showing roentgenologic outline of polyps of the gallbladder.

were thin no masses could be palpated in it. It was removed from the duct upward with separate ligation of the duct and the artery supplemented by transfixion of the duct. The gallbladder when opened was found to contain clear, yellow-brown bile and about a half dozen small polyps of the fundus region, two of which

men was closed in layers with interrupted sutures of silk throughout. A cigarette drain was brought out through a stab incision 2 cm. above the main wound.

The specimen consisted of an opened gallbladder measuring 7 by 3 cm. The serosa was smooth, the wall was not thickened, and the

mucosa was yellowish-green and smooth. There are three, 2 mm. masses connected to the mucosa with slender stalks measuring 0.5 cm. in length. These polypoid masses were the same color as the mucosa. Microscopically, there was infiltration of round cells in the wall of the gallbladder. The mucosa also contained a similar round cell infiltration and had hypertrophied at one point with the production of a polypoid adenomatous growth. This appeared benign in character. Impression: Polyposis of the gallbladder.

The postoperative course was uneventful. Treatment included large amounts of glucose and cevitamic acid. No complications developed, except for slight anemia. The drain was removed in four days, and the usual slight serous drainage persisted for three days from the drain wound. The patient was discharged twelve days after operation and was followed in the out-patient clinic for three visits, the last being one month postoperatively at which time she had no complaints.

COMMENT

Kirklin (1931) reported that in the seventeen-year period preceding 1931, at the Mayo Clinic papillomas were found in 8.5 per cent of more than 17,000 gallbladders surgically removed. He reported that the polypoid masses are small, seldom larger than 1 cm. in diameter, and may be single or multiple. When multiple there are usually not more than two or three and they tend to occur more often in gallbladders which are otherwise normal or present only faint microscopic signs of disease, but they may occur also in association with chronic catarrhal cholecystitis and with cholelithiasis, especially with a single stone. In only one instance was carcinoma noted among the 1,400 cases of gallbladder papilloma seen at the Mayo Clinic. This applies, however, only to the time of operation and does not mean that some others of these might not have become malignant later. Kirklin reported four cases at that time with roentgenologic diagnosis of papilloma confirmed at operation. In a later report (1933) he stated that he had made such a diagnosis in fifty-one cases. Operation was performed in fifteen cases and in fourteen cases the diagnosis was confirmed, while in the last instance only small cholesterin stones were found.

In 1931, Hefke reported a case diagnosed roentgenologically while Moore (1935) reported two cases in which the diagnosis could have been made, but was not done until after operation when the films were reviewed. In another of Moore's cases of adenoma, such a diagnosis was made before operation. Phillips (1933) reviewed the group of 500 gallbladders surgically removed at the Mayo Clinic between 1923 and 1929 which proved to contain one papilloma or more. They occurred especially in females, during the fourth and fifth decades of life, and in early disease of the gallbladder. Concerning malignancy, Phillips states: "Malignancy was seen in only one of my group of 500 papillomatous gallbladders, and even in that instance, not etiologically associated with papilloma. It would not appear that malignancy would occur any more frequently in papillomas than in adjoining villi, since papillomas are only hyperplastic villi laden with cholesterol."

SUMMARY AND CONCLUSIONS

A case is reported of polyposis of the gallbladder in a fifty-two year old woman diagnosed preoperatively by roentgen examination. A study of the literature reveals that papillomas of the gallbladder may occur in about 8 per cent of surgically removed specimens. The condition is especially apt to occur in females and during the fourth and fifth decades. Papillomas of the gallbladder are associated with early disease of the gallbladder, they occur in the fundus and may give rise to symptoms of cholecystic disease.

The possibility that papillomas of the gallbladder may be a source of carcinoma is to be considered but is as yet unproved. The realization that these lesions can be diagnosed roentgenologically is of great value in preventing this latter complication. Observations of a series of papillomas

diagnosed roentgenologically and followed in selected instances over a period of time presents the only sure means of deciding whether these lesions do lead to carcinoma.

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TWO-THIRDS of all human cases of actinomycosis occur in the neck and face. There is increasing evidence that the ray fungus gains entrance through a wound of the buccal mucosa, particularly after tooth extraction.

ABDOMINAL PREGNANCY

CASE REPORT

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ABDOMINAL pregnancy, while not uncommon, is regarded as one of the rarer complications of pregnancy. A large number of cases have been reported and much interesting literature has been published on this subject. Each case of abdominal pregnancy has been considered unusual enough to justify reporting from its individual standpoint.

I am submitting the following case as being of special interest, first because the patient had been operated upon a year previously for an extra-uterine pregnancy, and second because following her discharge from the hospital at this time she was readmitted a month later for removal of the placenta.

The interesting feature in these cases is, of course, what is going to happen to the placenta: (1) it is usually absorbed; (2) it may undergo necrosis and subsequent infection and form an intra-abdominal abscess which may later necessitate drainage; (3) the mass may become calcified as in any other foreign body in the abdomen and wall off. The first condition is the most likely to happen. There is a report of a case in the *American Journal of Surgery* for December, 1931, in which the placenta was left in and the abdomen was opened a year and a half later, at which time there was no sign of any placenta and no membranes could be found.

In the case herewith reported the fetus was a lithopedion, apparently full term; the thighs and legs were almost stony hard, as were the upper extremities. There did not seem to be any chin and this is in keeping with the findings of other men, about 30 or 40 per cent of fetuses in abdominal pregnancy presenting the appearance of monstrosities. The fetus in this case weighed 9 pounds, 4 ounces.

CASE REPORT

I. W., a white female, age twenty-three years, was admitted to the Lowell General Hospital on December 6, 1941. The patient had had an extra-uterine pregnancy one year ago for which she was operated upon and at which time a suspension of the uterus was done. She had had a previous appendectomy many years ago.

Upon her return from the hospital following the operation for this extra-uterine pregnancy, she continued to have abdominal pain of a crampy nature and this became so severe that she was hospitalized twice during the month of March for a few days each time, and she claimed that she did not get relief from the pain. Up until March her periods had been regular. Her periods stopped in March and she did not menstruate again.

She was seen for the first time in June and a vaginal examination at that time showed an enlarged uterus, which seemed in keeping with a three months' pregnancy. She still complained of generalized abdominal discomfort but I saw her several times during the summer and she had some discomfort but was up and about, leading a normal life except for the more than usual amount of abdominal pain.

I examined her in October and noted that the position of the uterus was transverse and rather high. The fetal heart was good, blood pressure and urine within normal limits. I saw her at times during October and November and her abdominal pain was so acute that she required codeine and sal codeia for its relief. I saw her the last time prior to her hospitalization about the 19th of October. At that time the fetus was still lying transversely and the fetal heart was good. Blood pressure and urine still normal.

* Dr. Dibbins is now a Major in the Medical Corps of the United States Army.

She was not seen again until the day of admission to the hospital when her family called and said she had not had a bowel movement for the past five days, even with the use of various cathartics. She was seen at her home and was obviously having severe abdominal discomfort. She was at term. The fetal heart could not be heard at this time and the patient stated she had not felt any movement for five or six days. The fetus was still lying transversely and high. Blood pressure was good; the heart action was a little rapid, pulse of 112, but otherwise negative.

On admission to the hospital an *x*-ray was taken, showing a full term fetus, transverse position; the fetus was very high in the abdomen with the head lying on the left, breech on the right. It was recommended that she have a cesarean section for the removal of a high transverse fetus, the family being notified that it was believed the fetus was dead and that this was the only proper method of delivery in this case.

I had a premonition that this was going to be a difficult operation and had a blood donor in readiness and soon after the anesthesia was started we began the use of saline intravenously, and while operating shifted over to blood and gave the patient a transfusion.

The abdomen was opened in the midline from the symphysis to the umbilicus, cutting out the old scar of the operation for extrauterine pregnancy. The peritoneal cavity was opened with difficulty. Considerable adhesions were encountered and once inside the peritoneal cavity what seemed to be an enlarged uterus, extending up about three to four inches above the umbilicus, presented itself. This was not the usual clear cut appearance of a uterus but all sorts of adhesions and scar tissue presented themselves. At the fundus there was a bluish area about two inches in length with soft tissue pouting through. I still was not thinking in terms of abdominal pregnancy and thought this was a rupture of the uterus, possibly with a pouting through of the placenta and a scarring over, and anticipated that behind this mass probably would be the fetus.

This area was incised and a finger inserted into what seemed like placental tissue, rather spongy, and bleeding rather easily, but no fetus. I kept going back to the fundus of the uterus and feeling this indurated mass of tissue, which seemed to separate up into the upper abdomen and while doing this evidently ruptured into the amniotic sac for immediately there was a spill of meconium. The hand was thrust in further and the fetus found. The fetus was removed with great difficulty; it proved to be a lithopedion, apparently full term; the thighs and legs almost stony hard, as were the upper extremities, and there did not seem to be any chin. Evidently on rupturing the membranes a vein was either ruptured in the membrane itself or in pulling the baby out of the abdomen the placenta was separated from its underlying tissue, and profuse bleeding ensued, just as if one had turned on a faucet.

Fortunately, the patient was being given blood transfusion but she was losing blood much more rapidly than she was getting it. I tried to pack off the area with large sponges and towels where I thought the blood was coming from, but the bleeding did not seem to stop. Finally, I pressed on the aorta itself and continued to pack, and after four or five minutes the bleeding was stopped. The cord was cut close to the placenta and it was believed that there was nothing else to do but leave the placenta *in situ*. As far as could be determined, the placenta was attached to the top of the uterus at the fundus, to the greater omentum, and possibly to the greater curvature of the stomach. I rapidly whipped together the incision I had made into what proved to be the placenta, and then very quickly closed the abdomen tightly, without drainage.

The donor who had been present and given a pint of blood was still in the ante room; he was recalled and another 300 or 400 cc. taken and given to the patient.

At various times during the operation, after the bleeding stopped, she was pulseless, with no blood pressure. At the close of the operation, after having received the transfusion and 2,000 cc. of saline, her pulse had returned with some volume.

In all she received 1,000 cc. of blood on December 6th, 550 cc. on December 7th, and 460 cc. on December 8th.

At the time of her discharge from the hospital she was running a low grade temperature, 99° to 100°F. down in the morning and occasionally going several days without any fever. She was discharged to her home in the ambulance on December 24th, the wound clean and well healed.

About a week after her discharge she began to show signs of placental absorption and began to run a fluctuation of temperature; having a rather high afternoon temperature, with a low morning excursion. Her color became poor and it was soon evident that she was getting a tremendous disruption of her red blood cells from the toxicity of the absorbing placenta. She was readmitted to the hospital on January 8th with a red blood count of 2,920,000.

An endeavor was made by transfusion to keep her blood picture ahead of her destruction but this proved unsuccessful, so that in spite of her poor condition it was believed there was nothing else to do but to operate and remove the placenta. In spite of 2,000 cc. of blood her red count went to 1,870,000 and the hemoglobin to 37 per cent.

On January 15th, the abdomen was opened by a left rectus incision and a black, foul smelling, necrotic placenta was found which was adherent to the sigmoid, mesentery of the small bowel, and small bowel and uterus. Where the placenta was picked off the sigmoid, a hole was left about one and one-half inches in diameter and this was repaired with several layers of interrupted silk sutures. Five gm. of sulfathiazole were left in the cavity and two cigarette drains packed into the cavity. Her condition at the close of the operation was fair.

On January 16th, the red count had increased to 4,001,000 and the hemoglobin to 96 per cent. On January 17th, she was given 750 cc. of blood. At this time she developed an edema of the lower extremities.

On January 18th, she showed evidence of a cardiac arrhythmia which responded to digifoline. The red count was 5,003,000 and blood chlorides 430 mg. She was given 250 cc. of plasma.

At times on doing the dressing there was a suggestion of a fecal odor, and on January 23rd a fecal mass about the size of an English walnut was removed. The discharge of fecal material gradually became less and on discharge from the hospital, March 8th, the fecal fistula was still present but very slight in amount, the wound granulating in nicely. She still had occasional edema of the left lower extremity and it was believed that there was some pelvic phlebitis which accounted for this condition. Her red blood count on discharge was 4,260,000 with a hemoglobin of 88 per cent.

In all, during this hospital admission, she received 750 cc. of citrated blood and 250 cc. of plasma.

She was seen at her home during the next two or three weeks. The fecal fistula practically closed and she was up and about, walking out of doors. The edema of the left leg was still present but not bothering her as much. She was eating well and her bowels moved normally. She had menstruated while in the hospital and continued to have normal periods after returning home. About the first week in May she returned to her work as a secretary.

CONGENITAL TERATOMA OF THE THYROID*

CASE REPORT

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TERATOMAS of the thyroid gland are of sufficient rarity to warrant the report of another case. In 1935,

FIG. 1. Lateral *x*-ray film of neck showing relative size and location of tumor.

Pusch and Nelson[1] published a review of the literature and collected forty-three cases. However, fifteen of these had been described before the microscope was in general use; and although many of them were undoubtedly true teratomas, they could not be classified as such. The remaining twenty-eight cases were accepted as authentic and the authors added a case from their own experience.

In 1938, Potter[2] reported a similar case thus bringing to thirty the total number of histologically proved cases in the literature.

Boyd[3] defines a teratoma as "a tumor consisting of different tissues or organs derived from more than one primitive germ layer." These lesions when found in the thyroid are usually in the lateral region of the neck. They frequently interfere with normal delivery of the fetus and many of the reported cases were found in stillborn infants.

The following case is a typical example of a teratoma of the thyroid. It does not demonstrate any features which have not been described but is of interest because it was surgically removed from a living infant and because it appeared clinically to be a midline tumor of the neck.

CASE REPORT

J. L. J. No. 37743, a three months old female negro infant was admitted to the general surgical service of the Children's Hospital on November 27, 1942. The mother complained that since birth she had noted a mass in the infant's neck and that its respirations had been heavy.

The infant, the mother's first child, had been born at full term after two hours of labor. She was delivered spontaneously as a vertex presentation without complications. She had received only breast milk since birth without complimentary feeding. The child had suffered no illnesses and had received no immunizations. The family history was negative except for a goiter in the mother and epilepsy in a maternal cousin.

At birth the mother had noted a swelling in the neck which was about the size of a golfball. Since then it had always been present but had varied in size occasionally, at times becoming larger and at other times smaller. There was no history of inflammation in the area. The mother had noted also that the baby breathed noisily

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at birth and had continued to do so, especially when lying down. The child had taken its feedings well with no apparent dysphagia and no vomiting. The stools had been normal.

infant cried. The mass was fixed to the deeper structures of the neck but the overlying skin was normal and non adherent. The remainder of the physical examination was not remarkable.

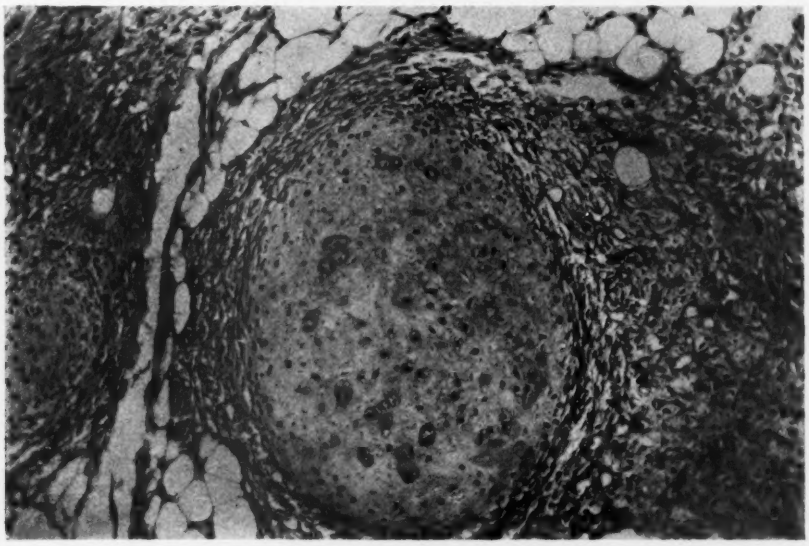

FIG. 2. Section of tumor exhibiting islands of cartilage and fat cells.

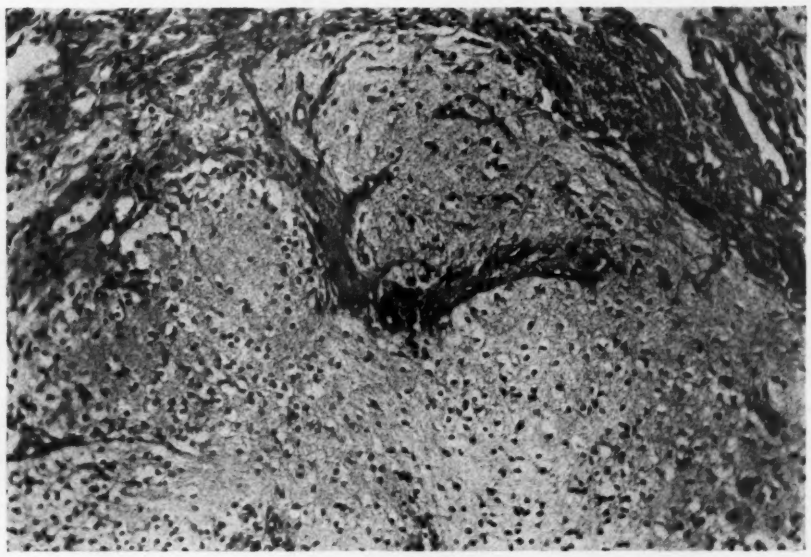

FIG. 3. Section of tumor exhibiting nervous tissue elements.

Physical examination revealed the patient to be a well developed and well nourished negro female infant, twenty-three inches in length, weighing twelve pounds eight ounces. There was a marked laryngeal stridor. In the neck was a smooth, firm, globular, non-tender mass which appeared to be in the midline and extended from the level of the hyoid bone to the suprasternal notch. The mass measured 5.0 cm. in maximum diameter. In some areas it felt cystic and it seemed to become tense when the

Laboratory studies were essentially normal. The erythrocyte count of the blood was 4.42 million, the hemoglobin 11.2 Gm. and the leucocyte count 8,100. The differential blood smear contained 68 per cent lymphocytes, 22 per cent polymorphonuclear neutrophiles, 9 per cent mononuclear cells and 1 per cent polymorphonuclear eosinophiles. The urine was negative. Blood Wassermann and Kahn tests were negative. Tuberculin tests were also negative.

Stereoscopic *x*-ray examinations of the soft tissues of the neck (Dr. H. G. Reineke) showed slight irregularity of the anterior tracheal wall due to pressure from an area of enlargement in the soft tissues. There was dilatation of the pharynx, suggesting a partial obstruction at the laryngeal level but no abnormalities were seen in the soft tissue immediately anterior to the spine.

The clinical diagnosis was tumor of the thyroid gland or thyroglossal duct cyst.

On December 3, 1942, the mass was removed at operation under endotracheal ether anesthesia. A transverse incision was made over the swelling in the neck. After reflecting the skin and platysma upward and downward, the underlying strap muscles were separated in the midline of the neck. Those on the right side were found to be stretched over the anterior surface of the mass and on reflecting them laterally the mass was found to lie entirely within the right lobe of the thyroid gland. It was well encapsulated and traversed by numerous small blood vessels. It was easily shelled out from its bed in the thyroid and had no direct communication with any structure other than the thyroid. After removal only a thin capsule of thyroid tissue remained to represent the right lobe. The left lobe and isthmus were normal. The wound was closed in layers with silk. It healed per primum and the infant was discharged from the hospital cured on December 16, 1942.

The pathologist's report (Dr. R. Johansmann) was as follows: "The gross specimen consists of a 3 × 4 × 5 cm. well encapsulated, lobulated tumor mass removed from the thyroid gland. The entire mass is composed of a large thick-walled cyst surrounded by a fibrous capsule. The wall of the cyst varies from 2 to 10 mm. in thickness. Masses of dense white tissue and light tan areas with tiny cysts are present in the wall. There is within the cyst and attached to it at several points, a large firm mass measuring about 3 cm. in diameter, which is composed of a light grayish white tissue spotted with light tan streaks, tiny chalky white spots, and larger, irregular, well outlined, grayish-blue, translucent islands of cartilaginous tissue. In the center of the growth there is a space, 2 × 5 mm. which is filled with a clot of blood.

"Microscopic description: Microscopic examination reveals a well encapsulated growth composed of a conglomeration of tissue representing all three primitive germ layers. There are numerous small and large islands of cartilage which in some areas are undergoing calcification. There are a few masses of osteoid tissue which are being converted into osseous tissue. Masses of nervous tissue, consisting of glial cells and fibrils, are scattered throughout the growth. In the centers of these masses are gland-like spaces, lined by tall columnar cells, resembling neuroepithelium. The larger cysts, noted on gross examination, are lined by tall, columnar, glandular epithelial cells supported by connective tissue and surrounded by incomplete rings of smooth muscle tissue. Some of these cysts are lined by stratified squamous epithelium, sometimes markedly flattened, while other cystic spaces are lined by alternate masses of stratified squamous and columnar epithelium. Islands of adipose tissue are also present as are areas in which there is proliferation of vascular endothelium with the formation of numerous capillaries. The remainder of the growth consists of connective tissue which for the most part is of highly cellular collagenous type, but in some areas is of the myxomatous variety. Several glands lined by a low or tall cuboidal epithelium and filled with pale pink colloid are present in the fibrous capsule. There are no signs of malignancy. Diagnosis: Teratoma of thyroid gland."

CONCLUSIONS

A case is reported of congenital teratoma of the thyroid gland which was surgically removed from a three months old infant and is the thirty-first authentic case report in the literature.

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INVERSION OF UTERUS*

REPORT OF TWO CASES AND A NEW METHOD OF HEMORRHAGE CONTROL

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POSTPARTUM inversion of the uterus is a rare condition, but once seen can never be forgotten. So rare is it that one of the latest textbooks on obstetrics fails to mention it at all. So rare indeed is it, that Braun states that of 250,000 births in the clinics respectively under the charge of Spaeth and himself, not a single complete inversion came to their notice, and in the Rotunda hospital in Dublin, one case was seen in 160,000 confinements.[1]

Inversion may be complete or incomplete. Howard Kelly states that it is more frequent in multiparous women[2] and in those under thirty, and that it is always accompanied by profound shock, which may be out of all proportion to the amount of blood lost. Death often occurs promptly from hemorrhage and shock.

According to Crosse's statistics one-third died either at once or within a month of the accident.[3] In a certain number of cases the inversion becomes a chronic condition; the patient by some miracle survives the shock, but continues to bleed from the exposed mucosa and becomes more and more anemic. Inversion comes on gradually, beginning as a little depression and then suddenly the fundus drops into the vagina, the patient utters a sharp cry and bears down. This bearing down has a tendency to increase the prolapse of the inversion.

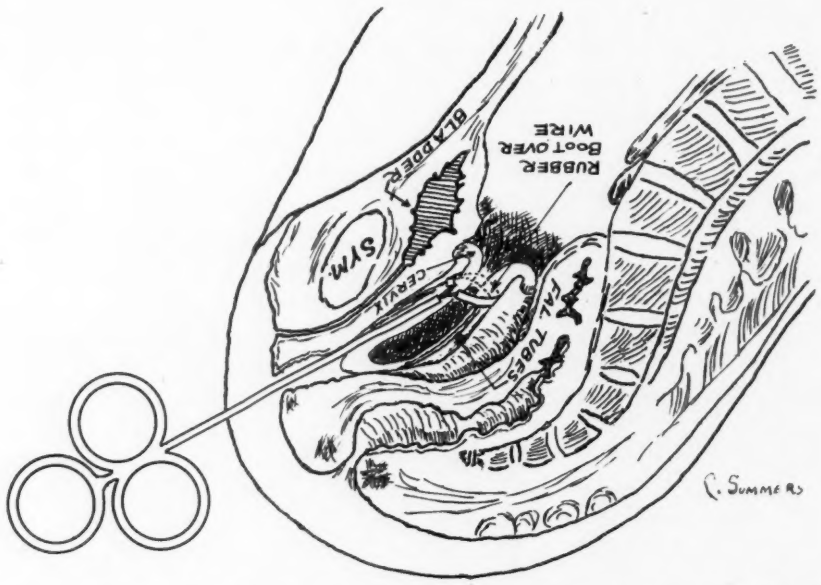

FIG. 1. Tonsil-otone with rubber tubing half around snare wire is pushed high over inverted fundus; when tightened it is a perfect rubber tourniquet.

De Lee describes the procedure of replacement as follows:[4] "After the whole hand, grasping the uterine body has replaced same in vagina, the constricting cervical ring is spread by means of fingers

* Presented before the Georgia Medical Society, Savannah, Georgia, May 25, 1943.

and thumb, while the palm of the hand forces up the fundus," (the thumb bearing toward the bladder while the backs of the fingers bear towards the rectum) "the outside hand (above the pubis) aids in dilating the fundus. Begin with even compression of the mass for three or four minutes."

My experience in Case 1 convinced me beyond any doubt that replacement is a very difficult thing to accomplish and in some cases it is utterly impossible.

CASE REPORTS

Case 1. Mrs. H. G., age thirty-five, a multipara, was brought to the Savannah Hospital in July, 1925. She had been sent from a town sixty miles away in an ambulance, arriving at eleven o'clock at night. When she reached the hospital she was in profound shock and shock treatment was given by the resident physician, who then called me from my summer home twenty-four miles away. Arriving fifty minutes later, I was informed that she had been delivered at about seven o'clock in the evening, at which time the attending physician made a futile effort to reduce the inversion. When I reached the hospital the patient was already in the operating room and examination revealed a complete inversion of the uterus. An immediate effort was made under light ether anesthesia to reduce the inversion, but the patient died in less than thirty minutes. I did not accomplish reduction.

CLINICAL LABORATORY RECORD

BLOOD

Date	3/23/42	3/28
Red blood cells		1,850,000
Hemoglobin	20%	58%
Color Index		
White blood cells		9,600
Differential Count		
Myelocytes		0
Young forms		2%
Band forms		4%
Adult polymorphonuclears		67%
Total polymorphonuclears		73%
Lymphocytes		23%
Monocytes		0
Eosinophiles		4%
Basophiles		0

Case 11. Mrs. L. H., age nineteen, a primapara, entered Warren A. Candler Hospital on March 22, 1942, with a history of delivery six months before at which time she had an inversion of the uterus. She was told by her physician that it had been replaced, but she suffered from a constant uterine bleeding with the passage of many clots from then to the present time. On admission her hemoglobin was 20 per cent; pulse 120; blood pressure 110/80. Vaginal examination revealed the uterus to be inverted; the cervix was constricted by a band in top of the vagina; the uterine fundus was in the vagina, practically filling it; the endometrium was absent; the uterus bled easily when touched; the perineum was tight. (Table 1.)

The vagina was packed with two-inch pack and sulfanilimide crystals and I ordered transfusions until hemoglobin reached 70. Vitamin K was given and extra nourishment, including liver extract and 200 mg. doses of thiamine chloride every other day; three transfusions of 500 cc. of citrated blood were given on alternate days. As the inversion had existed for six months it was manifestly impossible to accomplish reduction. On the fifth day after entering the hospital hemoglobin of patient was 60 per cent and I decided to operate.

Under ether anesthesia the tight perineum was incised and in order to perform a vaginal hysterectomy in this already depleted patient, and to avoid embarrassing hemorrhage, I used a tonsil snare in the following manner: (Fig. 1.)

A small rubber boot was fashioned to make a half circle on the snare wire so that when tightened the rubber protected wire would completely surround the uterus as near the constricted cervix as possible. (The bladder was not involved in the inversion.) When the snare was placed and tightened, I found that it not only acted as a perfect tourniquet, but also as a tenaculum and enabled me to pull the uterus well down and out, and with the electric cautery I quickly removed the fundus, with the loss of but a few drops of blood.

Because of the fact that the uterus had been inverted for six months with the tubes on a tight stretch, they were so atrophied that they appeared like jute hardware cord and they slowly retracted upward as soon as severed. I then sutured the stump, using a double running suture and gently pushed it up through the constricted cervix.

The patient made a smooth recovery, marred only by the development of a furuncle on the buttock, which was opened and drained on the fifth postoperative day. She left the hospital on April 6th, which was the fifteenth postoperative day.

CONCLUSION

I have briefly described a condition rare in obstetrics. It is probable, however, that it occurs much more often than has been recorded. In Case I, a complete inversion, reduction was impossible, even though the patient reached the hospital only a few hours after the inversion occurred. In Case II, a chronic inversion, with the fundus in the vagina, the patient responded to operative treatment in which a tonsil snare covered with rubber tubing was used to control hemorrhage. I recommend this simple method for use in similar cases.

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Torsion of the splenic pedicle sometimes occurs in the wandering organ. The torsion may be acute or chronic, acute cases presenting the symptoms of an intra-abdominal catastrophe. Chronic torsion may result in atrophy of the spleen, and after a period of indefinite abdominal discomfort all symptoms abate.

ABSENCE OF HALF OF THE LEFT DIAPHRAGM*

CASE REPORT

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CONGENITAL diaphragmatic hernia is a not uncommon lesion in infancy. It can be readily diagnosed. It can be successfully treated by transabdominal approach. The discussion of this entity by Ladd and Gross† cannot be improved upon and should be read by any one interested in the subject.

The report of this case is occasioned by the unusual defect present. No previous report of a successfully treated defect of this nature is known to us.

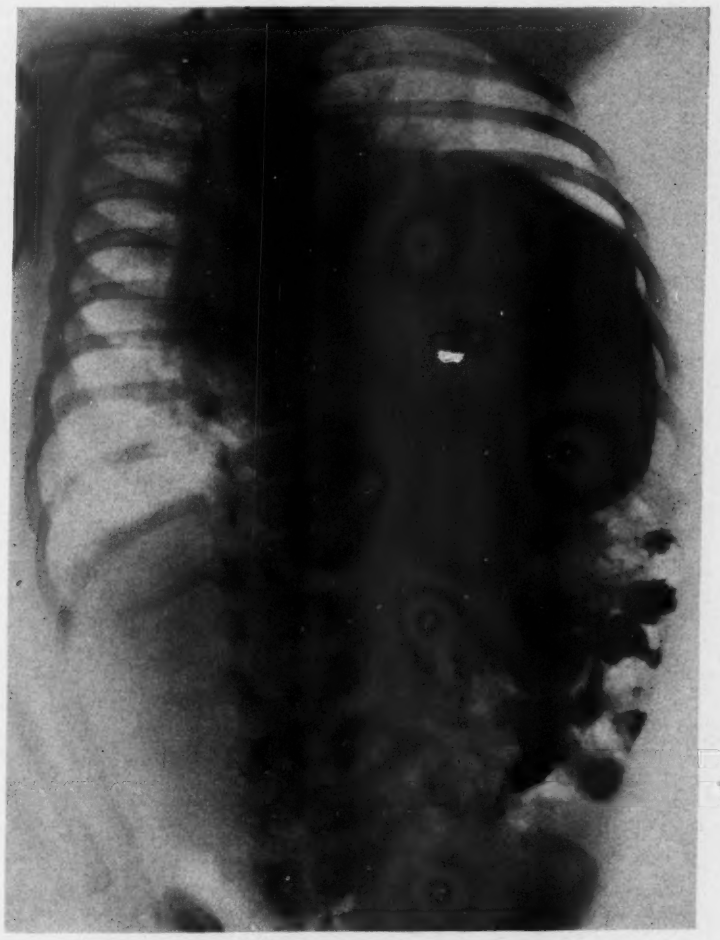

FIG. 1. Stomach filled with barium shown in left thoracic cavity.

CASE REPORT

This two-month old white male entered Doernbecher Hospital on August 14, 1942. This child had a depressed sternum and very rapid breathing, both of which were noted since birth. The child had to be fed small amounts at

†LADD and GROSS. Abdominal Surgery of Infancy and Childhood.

* From the Departments of Surgery and Pediatrics, University of Oregon Medical School and Doernbecher Hospital.

FIG. 2. A considerable portion of the large bowel is in the left thoracic cavity. The opaque shadow seen there turned out to be spleen.

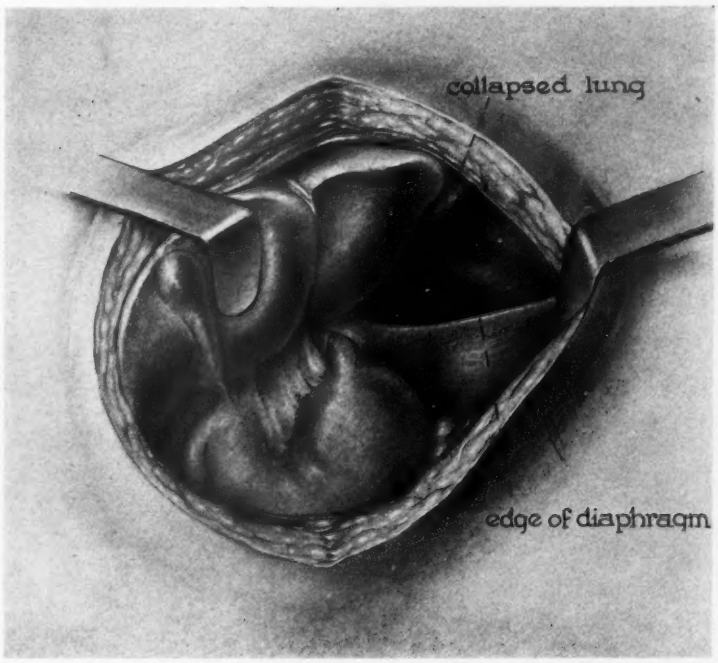

FIG. 3. Congenital absence of portion of diaphragm; appearance at operation.

frequent intervals, about two ounces every two hours. If fed larger amounts cyanosis developed.

The patient's temperature was normal. He barium meal. The heart was deviated to the right so that it lay almost entirely to the right of the dorsal spine. The stomach was displaced

Fig. 4. Postoperative view. The lung has re-expanded; the heart is still considerably displaced; the edge of the diaphragm is clear and although higher than normal appears to have separated the thoracic and abdominal cavities.

was a moderately well developed, well nourished white male. There was very marked retraction of the sternum in the region of the xiphoid. Respirations were shallow and quite rapid, and on visualization something seemed to be radically wrong with the child's breathing. Despite this the color was good. The child appeared very frail. Essential findings were confined to the chest. There was apparent heart shift to the right. Heart sounds were not audible in the left chest. There was tympany with absence of breath sound over the left chest posteriorly. However, there was normal lung resonance with breath sounds audible in the apex of the left chest. The right chest revealed normal lung resonance with normal breath sounds throughout. The liver extended 4 cm. below the right costal margin. Otherwise the abdomen was negative.

Urinalysis, hematology, and sedimentation rates were normal. Blood serology was negative. An *x*-ray of the chest was taken after upward into the left chest. The distal end of the esophagus was in the normal position. The barium enema revealed prompt filling of the colon, the splenic flexure of which was displaced into the left chest cavity.

From our findings and observations in this case, we believed that there was a definite herniation of abdominal viscera into the left chest cavity pushing the heart to the right and compressing the left lung. The child was prepared for operation. He was given nothing but saline by mouth. Twenty-four hours prior to the operation he received 10 per cent glucose in normal saline, 20 cc. per kilo, intravenously. In a few hours he received 80 cc. of human serum intravenously. Also he was given 150 cc. of Ringer's solution subcutaneously to secure good hydration. Blood for transfusion was secured.

Prior to operation the stomach was emptied by lavage. A continuous intravenous drip was started by cutting down on the vein, tying

needle into the vein, whereby he received 10 per cent glucose in distilled water throughout the operation. On August 20, 1942, he was given a general ether anesthesia and incision was made over the left clavicle. The left phrenic nerve was isolated and crushed. The abdomen was entered through an upper abdominal left rectus muscle splitting incision. The stomach, spleen, large bowel, and a good portion of small bowel were withdrawn from the left chest cavity. It was then found that the entire anterior portion of the left diaphragm was absent. The edge of the posterior half of the left diaphragm was sutured to the anterior abdominal wall and the anterior chest wall with interrupted cotton sutures. The defect was thus closed. The abdominal contents were able to be restored to the abdominal cavity without too great increase of intra-abdominal pressure. The abdominal wound was closed. The child withstood the procedure well but was immediately placed in an oxygen tent where he remained for six days.

During the first postoperative day the child had transient attacks of cyanosis and dyspnea. However, from the second postoperative day on the course was uneventful. Small feedings were started on the third postoperative day which were retained. The formula then was gradually increased until he was taking a normal feeding. Two transfusions of 80 cc. each were given. The continuous intravenous drip was discontinued on the third hospital day. Hydration was then maintained by subcutaneous fluid and by mouth. On September 3rd, x-ray of the chest revealed the heart was displaced to the left to a more normal position. There was a greater expansion of the upper portion of the left lung. Air could be identified in the stomach which was in a normal position. The abdominal viscera were seen to extend upward to the sixth rib posteriorly. The lung markings were seen to extend down to the eighth rib. In the lateral view, the left diaphragm was seen to rise posteriorly to the level of the fifth dorsal vertebra.

The baby has been followed at intervals and the lung has re-expanded and the abdominal viscera have remained below the diaphragm.

SUMMARY

A case of a two months' old baby with absence of half of the left diaphragm is reported. Satisfactory separation of the pleural cavity from the peritoneal cavity was established by suturing the edge of the posterior half of the diaphragm to the chest and abdominal walls.

ESOPHAGEAL VARICES

CASE REPORT

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THERE are two theories explaining the etiology of esophageal varices: One is that they are caused by a disturbance of the vascular regulating mechanism of the spleen and the other by an obstruction in the splenic or portal vein. The patient had no splenic anemia, but a portal block due to scar tissue formation following a liver infection secondary to acute peritonitis and appendicitis.

Crafoord and Frenckner, of Stockholm, as reported by Herman J, Moersch, of the Mayo Clinic, were the first to report the successful use of sclerosing solution for esophageal varices. Moersch reported eleven such cases. These men devised special instruments for this procedure. The writer used an ordinary esophagoscope with a metal suction tube attached to a tonsil needle to inject the sclerosing solution.

The patient had received twenty-four transfusions and it was believed that these transfusions merely replaced the lost blood. It was becoming increasingly difficult to replace this loss. This case report is presented not only to add another successful case to the literature, but also to show that the injection of a sclerosing solution through the esophagoscope in cases of esophageal varices may at times be a life-saving procedure.

CASE REPORT

D. P. No. 232282, a fifty-year old, white male, was admitted to the Jewish Hospital of Brooklyn, on March 25, 1942, with the chief complaint of hematemesis. He gave a past history of having been operated upon for appendicitis in 1936, with a stormy and prolonged hospital stay (163 days), due to development of multiple liver and intra-abdominal abscesses postoperatively. He underwent six operations during his stay and finally recovered. He then felt well until May 10, 1940, a period of about three years, when he had his first attack of hematemesis. He was hospitalized for eight days, during which time investigation resulted in a diagnosis of esophageal varices due to pyelophlebitis. This was verified by *x*-ray. The next episode of hematemesis occurred in October, 1940, when patient was again hospitalized and a transfusion of 500 cc. of citrated blood was given.

Since that time, the patient had had occasional episodes of tarry stools and hematemesis. He received treatment for anemia from his family physician. In the three days prior to this admission, the patient had two bouts of hematemesis. Because of a feeling of weakness and a drop in systolic blood pressure to 80 he was hospitalized.

Physical examination revealed a well developed and well nourished white male, with marked pallor; blood pressure 115/70. There were no abnormalities noted. Scars of previous operations were well healed and firm.

At 11 P.M., March 25, 1942 on the day of admission, the patient vomited 700 cc. of bright red blood. He became cold and clammy; his pulse was rapid and of a poor quality, and blood pressure was unobtainable. The patient was placed in the Trendelenburg position and warmth, nasal oxygen and continuous intravenous fluids given. Transfusion was ordered. Hemoglobin was 30 per cent. On March 26th, at 1 A.M. a transfusion of 500 cc. of citrated blood was given. At 12 noon, the patient vomited one liter of blood. At 1:45 P.M., a transfusion of 500 cc. of citrated blood was given; hemoglobin was 52 per cent. At 10:30 P.M. the patient vomited 900 cc. of bright red blood. On March 27th at 12:30 A.M. a transfusion of 500 cc. of citrated blood was given rapidly. The patient was in shock and was

comatose; the pulse was barely perceptible. At 1:30 A.M. another transfusion of 500 cc. of citrated blood was given. Blood pressure was 100/40, pulse of fair quality. At this stage a surgical consultation was deemed advisable (Dr. Paul Aschner). At this consultation the history was again reviewed and the *x*-rays restudied. The consultation confirmed the diagnosis of esophageal varices resulting from interference with venous circulation complicating previous intra-abdominal disease. Two courses of treatment were possible: either the passing of the esophagoscope and attempt to control the bleeding by electrodesiccation or the injection of sclerosing agents into the varicose veins. At 1:15 P.M. a transfusion of 500 cc. of citrated blood was given. At 6:30 P.M. patient vomited 800 cc. of bright red blood and had a bloody (frank blood) bowel movement. Patient complained of pressure-like, precordial pain, probably due to cardiac anoxemia resulting from a low hemoblogin (40 per cent); temperature 103°F. At 7:45 P.M. another transfusion of 500 cc. of citrated blood was given.

On August 28th, at 2:30 A.M. a transfusion of 500 cc. of citrated blood was given. At 7 A.M. he vomited a small amount of blood. The patient was receiving intravenous fluids and nasal oxygen. At 9:30 A.M. another transfusion of 500 cc. was given; hemoglobin was 40 per cent. At 5:15 P.M. he had two tarry stools and vomited a small amount of blood. Another transfusion of 500 cc. of citrated blood was given. His temperature was 103°F., no blood pressure was obtainable. At 7 P.M. the pulse was weak and thready; blood pressure was 70/40. Another transfusion of 250 cc. of citrated blood was given at 9 P.M.

On April 2nd, his condition somewhat worse. The patient continued to spit up blood and pass bloody stools. Hemoglobin was 32 per cent, temperature 100.4° to 101°F. The patient received five more transfusions. Abdominal distention now appeared. He was seen by Dr. Blatteis who thought that the prominent abdomen was due to edema of parietes and not to free fluid in the peritoneal cavity. There was also some subcutaneous edema along the posterior chest. No pleural fluid was present. Fluids were restricted and no saline in any form was to be given. The patient did not vomit that day.

On April 8th, vomiting and passing of blood per rectum had recurred. He received five more transfusions; hemoglobin 32 per cent, temperature 101°F. Dr. Blatteis stated that bleeding from the esophageal varices seemed to come in form of continuous oozing. Transfusions merely replaced loss of blood and it became increasingly difficult to supply or replace the loss; other measures indicated for the profound anemia were being employed. It was argued that the varices were not due to the cirrhosis of the liver, but rather to interference with the venous circulation from the many adhesions, bands, etc. which must have resulted from the numerous operations. The prognosis was exceedingly grave.

On April 10th, the patient's condition was not very favorable; hemoglobin was 29 per cent. The patient was taken to the operating room for esophagoscopy. At the lower third of the esophagus the lumen was about two-thirds obstructed by five or six rather large, tortuous varicosities. The largest of these were at 12 and 6 o'clock, respectively. Through a No. 25 tonsil needle, 2 cc. of sodium morrhuate were injected at 12 o'clock. This was followed by a gush of blood. The patient withstood the procedure fairly well. Postoperatively, a transfusion of 500 cc. of blood was given.

On the following day, bleeding had ceased. He was comfortable, complained only of slight soreness on swallowing; hemoglobin was 35 per cent.

On April 14th, bleeding has not recurred; hemoglobin was 43 per cent. Esophagoscopy was again performed. Varicosity at 12 o'clock was much smaller and blanched in appearance. Varicosity at 6 o'clock seemed to be fused with varicosities at 7 o'clock and was markedly dilated in appearance. This vein was then injected with 2 cc. of sodium morrhuate. No reaction of note occurred. Postoperatively, a transfusion of 500 cc. of citrated blood was given.

Two days later his condition continued to improve and there was no further bleeding. A transfusion of 500 cc. of citrated blood was given; hemoglobin was 54 per cent.

On April 21st, hemoglobin was 61 per cent. His condition was markedly improved and he was esophagoscoped again. Varicosities were smaller, even those which were not injected. Marked pulsations were noted in one, which apparently overlay the aorta and this was injected with 2 cc. of sodium morrhuate. This was followed by a gush of blood on withdrawal. A transfusion of 500 cc. of blood was given.

It was believed by the writer that no further therapy was indicated as the patient was not bleeding any more.

On April 28th, hemoglobin was 65 per cent. There was no evidence of bleeding. The stools were brown in color and hemoglobin was increasing. Pulse was 96 and lungs were clear. Abdominally, the spleen was 4 cm. below the costal arch; the liver could not be made out; the abdomen was soft with no tender points. The general condition of the patient was highly satisfactory, both mentally and physically. With the exception of a secondary anemia none of the other collateral evidences of his condition were observed. He was discharged greatly improved.

On March 15, 1943, the patient was seen by the writer. He states that no vomiting of blood had occurred since the last esophagoscopy. He did, however, have an episode of nasal bleeding from the right nasal vestibule that was easily controlled by application of local cautery. He continues actively at work and considers himself in good physical condition.

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Medical treatment sometimes relieves symptoms, but never removes stones from the gall bladder. Unless there is some definite contraindication to operation the correct treatment for stones in the gall bladder is cholecystectomy.

TREATMENT OF FRACTURE OF ASTRAGALUS BY INTERNAL FIXATION WITH METAL PIN

CASE REPORT

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REPORTS on the treatment of fractures of the talus are confusing and indefinite. Although several authors, Olivecrona,[1] McWhorter,[2] Key and Conwell,[3] Miller and Baker,[4] Speed and Smith,[5] Boyd and Knight,[6] and Schrock, Johnson, and Waters,[7] advise internal fixation in cases in which anatomical apposition of fragments cannot be obtained by the closed method, many others are pessimistic about the end results; some even advise arthrodesis and astragalectomy (Cole and Elman,[8] and Steindler[9]). The purpose of this paper is to report a case in which internal fixation of a fracture of the body of the astragalus was accomplished with a Kirschner wire with a good end result after several attempts to reduce the fracture by the closed method failed to produce adequate apposition of the fragments.

FIG. 1. *X*-ray of ankle showing fracture of talus and the anterior lip of tibia.

CASE REPORT

R. L. H. a twenty-one-year old white soldier, while on duty slipped and fell from a height of sixty feet landing on his feet. He experienced excruciating pain in the right ankle immediately on striking the ground. He was brought to the hospital about two hours after sustaining the injury. Medical history was entirely negative except for the complaint involving the injury to the right ankle and foot. General physical examination on admission revealed a well developed and nourished white male, conscious, rational, and not in shock or acute distress. There was a great deal of ecchymosis, marked swelling, and tenderness

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present over the right ankle. *X*-ray of the right ankle revealed a fracture of the body of the astragalus just beyond the neck running downward and backward to the posterior facet of the calcaneus. The fragments were separated and the anterior fragment raised so that it impinged on the anterior surface of the tip of the tibia where a small fragment was chipped off but only slightly elevated. (Fig. 1.) Laboratory studies of blood and urine were not remarkable. Because of marked swelling and ecchymosis about the right ankle it was decided to delay manipulation of fragments. The leg was placed in a bivalved cast. Eight days after injury was sustained the swelling had diminished sufficiently to warrant attempting to reduce the fracture by the closed method, but this was to no avail. Due to injury to the skin about the ankle during manipulation it was necessary to delay open operation an additional eight days.

Under spinal anesthesia using 150 mg. of procaine a two and one-half-inch incision was made on the dorsomedial aspect of the right foot, just below and in front of the medial malleolus. After approximating the fragments a Kirschner wire was driven into the neck and directed backward and laterally. About 3½ cm. of the wire was driven into the body of the astragalus and then *x*-ray was taken to check the position of the wire. The wire was then cut flush at the neck and the wound closed in layers. (Fig. 2.) A plaster of paris cast was applied extending from the toes to the knee.

The postoperative course was uneventful. A walking caliper was applied to the cast two weeks after operation and the patient allowed to walk. The cast was removed seven weeks after operation and the patient started to walk with the aid of crutches one week later. There was gradual return of motion at the ankle and by the ninth week the patient started bearing weight on the ankle. Rehabilitation of the involved ankle and foot was progressive with subsequent discharge to field duty on the eleventh week when he had approximately 50 per cent function of the ankle. Because the soldier was unable to carry on with full duties in the field he was returned for reclassification. A letter from him one month later stated that he was given a sick furlough from a General Hospital at the termination of which he would return to field duty. Further he stated that he still walked with a slight limp and had occasional pain in the ankle. The patient wrote this message twenty-one weeks after date of injury.

Fig. 2. Postreduction film showing Kirschner wire in place.

SUMMARY

A case of a fracture of the body of the astragalus of the right ankle, treated by internal fixation with a Kirschner wire and followed for a period of five months

after operation, is presented. The availability of the material for the type of operation described above makes it a simple procedure and can be used in combat zones as well as in civilian hospitals. It is believed that fractures of the body of the astragalus which cannot be reduced by the closed method should be treated by open reduction and internal fixation.

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In early cases of peritonitis, if the focus of infection be removed the abdomen often can be safely closed without drainage. The capability of the peritoneum to overcome a certain amount of infection is truly remarkable.

The brief excerpts in this issue have been taken from "A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (H. K. Lewis & Co. Ltd.).

Bookshelf Browsing

EVOLUTION OF BONE GRAFT SURGERY

FRED H. ALBEE, M.D.

NEW YORK, NEW YORK

THIRTY-FIVE years ago, the writer published his first original use of the bone graft in arthodesing the hip joint, and it is now over twenty-six years since he set himself to the task of writing the first book published in any language upon the sole subject of Bone Graft Surgery.

Seven years before this, in 1908, he was unable to induce Dr. Alexis Carrel to settle for all time, by animal research, whether the detached autogenous bone graft would uniformly live and prove to be a dependable surgical agent for surgical bone reconstruction. Fortunately, for the writer's enlightenment, Dr. Carrell was so busy with his world famous chick heart work that he could not turn aside to do the bone graft research. Therefore, from necessity, it was decided that he use his evenings and nights and do the work himself, and fortunately, because of his occupying the Chair of Orthopedic Surgery at Cornell University Medical College at that time, ample facilities at the Loomis Laboratory and Animal Hospital on East 26th Street, New York City, were available.

Of the great variety of research on dogs done during those years, the fusion of the dog's spinal column by a free graft from his own leg was the most outstanding. One important principle was proved in the very beginning, and that was the untrustworthiness of heterogonous grafts—bone grafts from sheep when implanted into dogs and vice versa. The bone graft was always found to be demarcated from the surrounding bone by a cavity filled with serous fluid.

The encouragement from these most gratifying results led to the writer's immediately starting the fusion of the human spine for tuberculosis and various other reconstruction work by bone graft, which has continued with increasing success during the past thirty-five years. (Fig. 1.)

Over this extensive span of years, the trustworthiness and dependability in a wide variety of such work has been amply proved in clinical practice. Bone graft operations were then relatively few but have since been adopted by the surgical profession the world over in various classes of cases otherwise considered hopeless.

It has been most gratifying to the writer during this period to observe in his extensive travels the constantly increasing surgical uses of the bone graft. These travels have consisted of twenty-four visits to Europe since 1909, to every State in this country and Canada, to every country in Central America, the Antilles and every country in South America, excepting one.

The author's original technic of bone transplantation, although fundamentally unaltered since the early days of its inception, is being utilized today in an ever increasing variety of ways for the cure of disease and numerous examples of derangements of the bones and joints. The reparative influence of the bone graft enables the reconstruction surgeon to keep pace with the unfortunate sequelae of industrial and road accidents. The therapy of congenital absence of such bones as the radius, tibia and fibula, as well as congenital non-union can now be undertaken

with greater assurance than was possible heretofore. The Albee bone graft spine fusion operation has rendered the treatment of a wide variety of affections of the spine less formidable, including Pott's disease, vertebral fractures, congenital malformations, scoliosis, (Fig. 2A, B, and C), spondylolisthesis, and diseases of the sacroiliac joint.

The graft has been of no less usefulness in successful arthrodesing, without exception, all other tuberculous joints by extra- or intra-articular methods (1919) (Figs. 3 and 4.) In congenital dislocation of the hip in which, because of shallowness of the acetabulum, the femoral head will not remain in place, the bone graft has made possible the deepening of the hip socket by

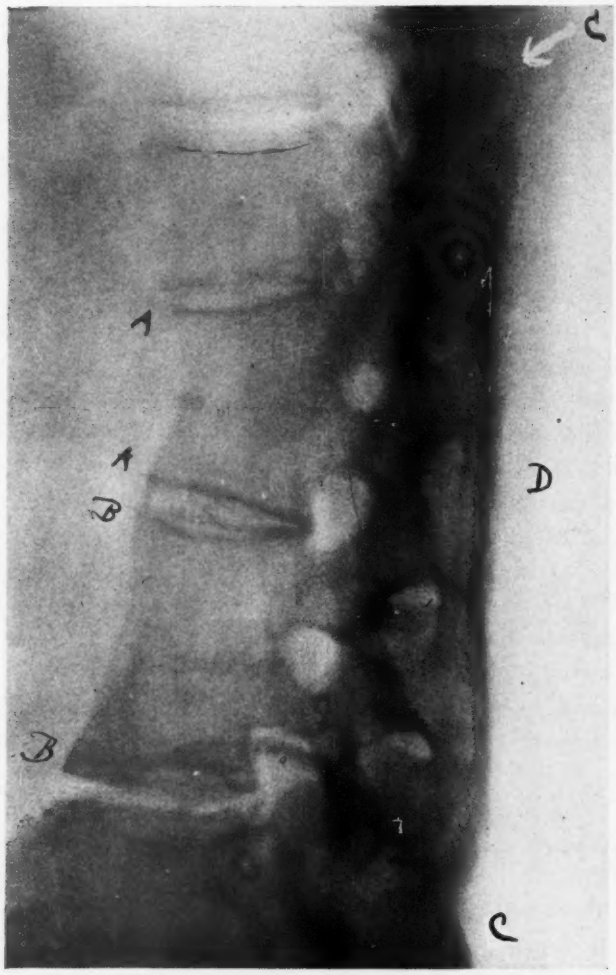

FIG. 1. Case V. D. Roentgenogram showing excellent spine fusion for acute Pott's disease of lumbar vertebrae twenty-six years after implantation, at different times, of two tibial inlay bone grafts CC, fused to each other at D, as well as into the lumbar spine, for two foci of acute tuberculosis in the vertebral bodies at AA and BB. This case was complicated by a tuberculous epididymitis. The first spinal operation was performed when the child was five years of age, and the subsequent one eight months afterward. Later the patient became a seaman and engaged in the most strenuous type of activity. It should be noted that there has been a complete healing of the tuberculous processes with firm fusion of the vertebral bodies themselves.

the so-called "shelf" operation (1915). If, because of structural shortening or other causes, it is impossible to bring the femoral head downward to the acetabulum, the bone graft has made it possible to erect a shelf-acetabulum over it on the side of the ilium at its most favorable site.

The bone graft peg is believed to be the ultimate solution as primary treatment of those cases of central fracture of the neck of the femur (1913), when the ligamentum teres was ruptured at the time of fracture, which has been proved a very frequent occurrence. The autogenous peg is also the method of choice in non-union of the hip; and if the degree of femoral neck absorption prohibits the use of the peg, the removed femoral head modeled to a wedge serves to reconstruct the hip and restore its kinesiology (1919). The author, in 1908, was the first to offer an operation for arthrodesis of advanced osteo-arthritis

Fig. 2A. Case E. P. Idiopathic scoliosis. Corkscrew spine after prolonged unsuccessful treatment by corrective exercises, braces, plaster jackets and traction.

(senile coxitis) and other conditions. In fact, the bone graft is an important feature in procedures for ankylosing all joints for a multitude of conditions. Replacement of congenital absence of bone such as the radius, ulna, tibia or fibula, has been made possible.

The radical massive resection of malignant bone tumors and immediate restoration of the involved portion of the skeleton by transplanted bone has marked a new achievement for the man who does bone surgery. (Figs. 6A, B and C, and 7A, B and C.) In fact, the author's statistics of selected cases done by him during a period of twenty-one years, shows that although

FIG. 2B. Case E. P. *X*-ray of Figure 2A, four years after implantation of grafts in accordance with schema (Fig. 2C) showing particularly the prop graft at BB holding securely the corrected position of ribs after they were extracted from within the pelvis at operation. The graft is firmly united with the tenth rib and pelvis at BB. Note increased diameters and density of tenth rib, also hypertrophy of spinal graft at AA. This is because of the biological reaction to the laws of stress (Wolff's law). Full correction was not attained because of extreme contracture of soft tissues on concave side following extended conservative therapy. This patient now indulges in the most strenuous of exercises, including skating and tennis.

limbs are saved by such methods, still the risk to life is no greater than when the limb is sacrificed by amputation. The ravages of poliomyelitis have been tempered by the judicious application of arthrodesis and bone graft block operations. The limitations of tendon transplantation are becoming more clearly defined and a greater reliability reposed when associated with stabilization and reconstruction kinesiologic operations upon the skeleton. The most recent contribution of the author in this field is concerned with the partially paralytic hip, for which he has devised a method to elongate the kinesiologic lever at the top of the femur for the purpose of obtaining a more stable hip and a stronger weight-bearing limb. The functional strength of the weakened abductor weight-bearing muscles is increased by lengthening the bony lever which they pull upon. Such muscle weakness has resulted from infantile paralysis, nerve involvement of the corda equina of the spinal cord and other nerve injuries, old local muscle destruction, etc. The operation, possible because of the bone graft, has also been found to be effective in a number of other conditions in which the lever has been shortened, namely, in epiphysitis of infancy, etc., destruction from tuberculosis, congenital dislocation (Fig. 5A and B), insufficiency of the trochanter following arthroplasty and non-union of the hip with absorption of the femoral neck.

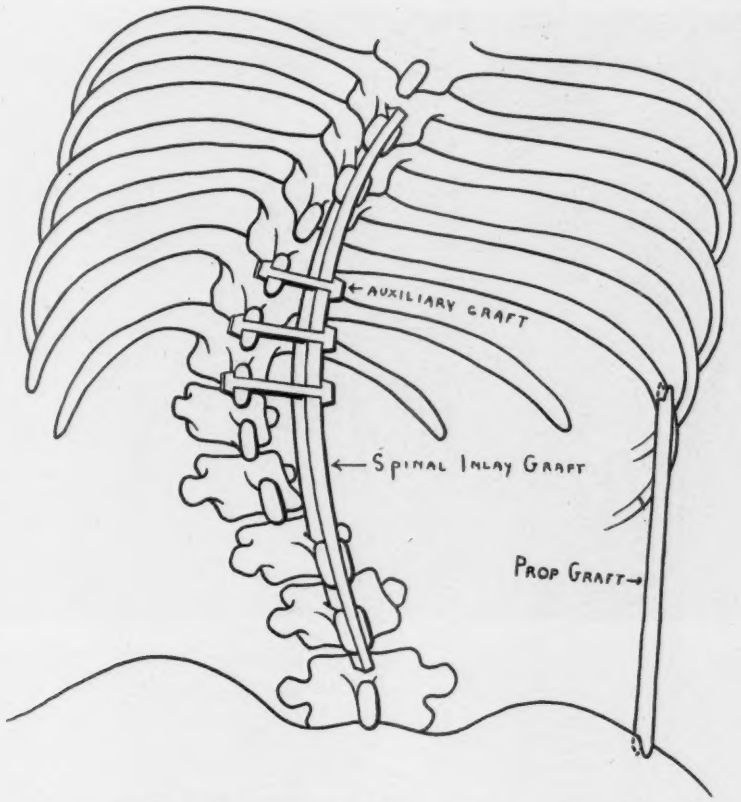

Fig. 2C. Schematic representation of prop graft. (Fig. 2B.) Note interlocking of graft and tenth rib, also auxiliary grafts at right angle to spinal graft where it is impossible to mold the graft to a sufficient curvature.

The query must thus be made, why is it possible to bring about results in cases otherwise hopeless by this radical departure from older surgical procedures?

The principal reasons are: First, the development and the availability of the *x*-ray; second, the perfection of the small universal electric motor, and consequently the electrically driven bone mill; third,

the fracture-orthopedic traction operating table, and last, the proof of the dependability of the survival of autogenous bone

Fig. 3. Case N. H. Tuberculosis of the right hip. Failing to yield to long conservative treatments, it was cured by extra-articular tibial bone graft fusion at A and B.

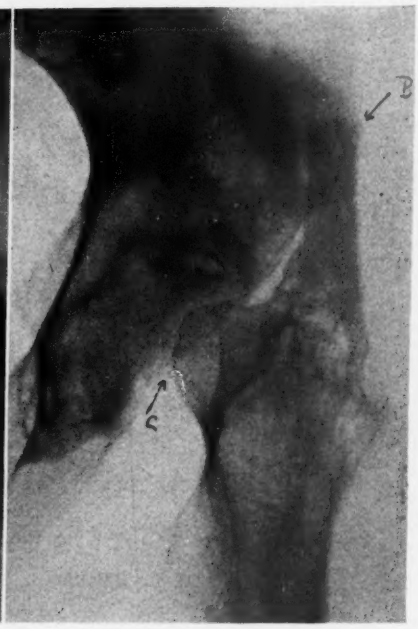

Fig. 4. Same case as Figure 3. Four years after cure by bone graft fusion, and one year and two months after arthroplasty securing approximately 50 per cent of motion at hip by the incomplete removal of graft at A (Fig. 3) and leaving large portion of graft at B (Fig. 3) as a kinesiologic lever to stabilize by the attached muscles the active function of the newly made joint. The modelling of the new joint is shown at C.

transferred for any reparative purpose from one part of the body to another. The evolution of a surgical armamentarium for cutting and modelling hard bone approaching the precision and rapidity of operation of power-driven precision tools of the machinist or cabinetmaker has played the most important rôle. The advantage of this is because of biophysiological requirements.

It should be realized from the outset that the method is revolutionary in that repair, reconstruction, changing of outlines and architecture and the changing of the kinesiologic mechanism of the skeleton has been for the first time made possible.

These hitherto impossible accomplishments have been made possible because transferred living bone tissue becomes a part of the osseous system wherever it has been implanted. This transplant takes on all the functions of supporting living tissue; it serves to convey vessels from one portion of itself to another as well as from one element or part of the skeleton to another. This is best demonstrated by the case of the synthetic construction of a digit of the hand, when bone grafts of as much as four and one-half inches in length have been inserted into a boneless finger made up of recently transplanted skin and subcutaneous tissues obtained from the abdomen or elsewhere. Nerve supply extends to the tip of such constructed digits in about one year. Such cases have been observed by the writer over periods of more than twenty years, including *x*-rays and histopathological examinations. These grafts increase in size and strength in accordance with functional demands and co-ordinately with the necessary increase of number and size of inherent blood vessels in the interior of

the graft itself. This has been shown by repeated *x*-ray and pathological examinations. The phenomenon of tissue survival and growth demands this. It is merely a part of the biophysiology of living bone in its growth maintenance and repair. If, because of trauma or disease, blood is needed at a remote portion of a bone, whether it be a part of the skeleton or bone graft, nature provides a collateral circulation to bring blood from another part of the same bone.

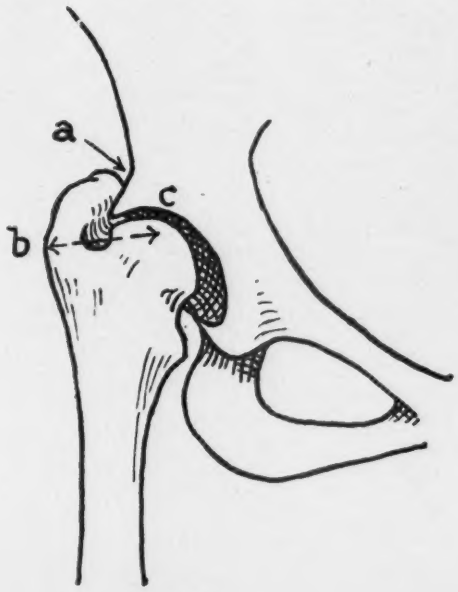

FIG. 5A1.

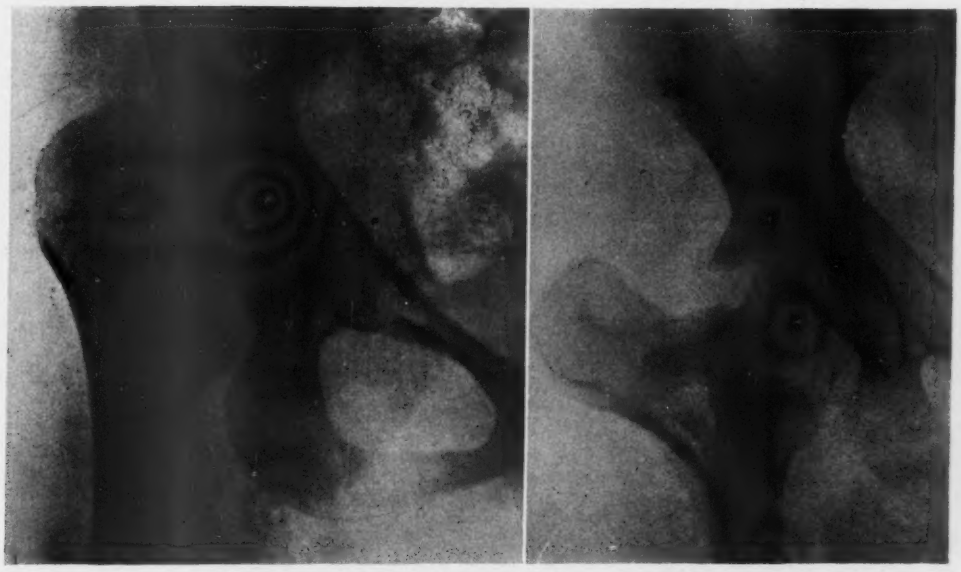

FIG. 5A. FIG. 5B.

FIG. 5. Case S. K. A, roentgenogram and accompanying schema (Fig. 5A1) showing marked congenital shortening of the kinesiological lever with a pronounced bone block to abduction at A in a case of congenital dislocation of the hip long after its reduction. B, a very recent roentgenogram showing postoperative result in the same case as Figure 5A. The bone block has been moved and the lever has been markedly lengthened by displacement of the greater trochanter outward. A rectangular graft from the outer table of the ilium of the same side has served to hold the trochanter in its outward position as well as to fuse it to the upper portion of the femur.

This property of the graft is extremely important in its surgical applications to the cure of disease or in various problems of bone repair, such as spinal tuberculosis, or un-united fracture of the neck of the femur. In the first instance, it serves besides immobilization and mechanical support, to conduct blood from the posterior cancellous part of the healthy vertebrae on either side of the disease over to the diseased anemic portions of the vertebral bodies.

In the second instance, the sizeable bone graft peg serves: First, to immobilize the subcapital fracture of the neck of the femur; second, to bring or stimulate callus formation, or osteogenesis to the fracture junction; and last but not least, to convey by collateral circulation, developing in the graft itself, blood from the vascular trochanter region to the anemic capital fragment and to the fracture junction.

A B C

Fig. 6. Case B. S. Malignant osteochondrosarcoma of the right femur. Resection of one-third of lower portion of femur leaving condyles of the femur. A, three months after bone graft operation. The shaft was resected, but the epiphyseal cartilage was left intact. B, four months after operation showing extensive enlargement of bone graft and callus deposition. C, complete restoration of the shaft of the femur two years after operation. It is now seven years, lacking two months, since the operation, and there has been no evidence of local recurrence or metastases. Note diameter of bone graft equals normal diameter of femur with marrow cavity developed through it.

The writer has found that in non-union of this fracture coming to his reconstruction operation with removal of the femoral head, the ligamentum teres (the sole remaining source of blood supply to the capital fragment) has been torn or destroyed in 98 per cent of cases at the time of fracture.

The principles of grafting living tissues are exemplified in their simplest form in plant grafting. One can safely assume that the principles of plant grafting cannot be violated in the grafting of tissues of a higher form; and that grafting of bone cannot be as readily carried out as grafting of vege-

table material. These postulates arise from the very nature of biological principles and the decrease in adaptability with increase in specialization of tissue. There are three inviolable rules in plant grafting: The tissue must be applied like to like; the contact must be most intimate; and they must be immobilized in that position. These principles are important but not as necessary in bone grafting. In fact, there is a close biologic parallel between wood and bone in that they are both supportive tissue, and although one is of the vegetable and the other of the animal kingdom, they both present identical response to the laws of stress.

A B C

Fig. 7. Case S. K. Osteogenic sarcoma of the lower end of the femur involving the condyles of the femur and necessitating the removal of the knee joint as well as over one-third of the lower shaft of the femur. A, *x*-ray taken immediately after resection and replacement by tibial bone graft. B, lateral *x*-ray view taken two and one-half years after operation. C, anteroposterior view taken two and one-half years after resection and replacement by bone graft showing that the graft has reached the diameter of the shaft of normal femur which shows in the upper portion of the *x*-ray. This *x*-ray also shows the development of a marrow cavity through the bone graft itself. It is now seven years since resection of malignancy and there is no recurrence or evidence of metastases.

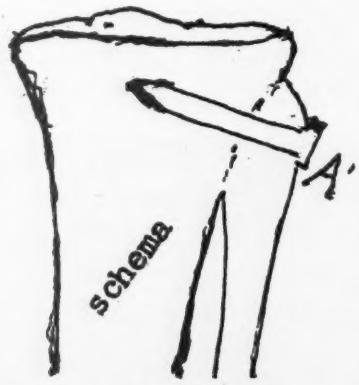

Fig. 8B1.

Fig. 8A. Fig. 8B.

Fig. 8. A, This is the case of a famous polo player who came to the author after having been treated unsuccessfully at many clinics for five years for pseudoarthrosis and osteomyelitis. Roentgenogram shows ununited fracture of the upper third of the tibia with loss of bone. g, Shows sequestrum which was removed and wound healed by the use of bacteriophage. B, this *x*-ray shows same case as Figure 8A after cure of osteomyelitis and the securing of union by means of inlay bone graft B in tibia, and fusion of tibiofibula joint with bone graft peg at A. In the treatment of ununited fractures in the upper end of the tibia, the author has for many years used, as a supplementary supportive measure, fusion of the tibiofibula joint.

Precisely as Sandow's bones increased in diameter, weight and strength because of the increased mechanical demands of stress the sap must permeate the cells of the scion or the latter will eventually die. In bone, reestablishment of the blood circulation

A B C

Fig. 9. These three *x*-rays illustrate the case of a child suffering from healed osteomyelitis with subsequent loss of bone which was restored by bone graft. A, shows extensive loss of tibial bone at AA. B, shows replacement of this loss of bone at BB. C, shows the hypertrophy of the graft at CC with its diameter the same as the rest of the tibia. This lateral view shows a marrow cavity developed through the graft.

coming to them from muscular development, or the reverse influence from infantile paralysis, so does the living wood tissue respond to increased stress. The bone graft responds in exactly the same way. They are both supportive tissues. (Figs. 6, 7 and 9.)

The re-establishment of the circulation is simpler in the plant, but it is obvious that becomes a problem, the solution of which governs the whole question of surgical technic.

Immobilization is affected in plant grafting in two ways: In addition to the fixation provided by the accurate inlay fit of the scion, the junction of grafting is either bound with many layers of fabric or is covered with wax, or better, paraffin. These

sealing substances serve as a sterile dressing as well since they keep out fungi. If paraffin is used, immobilization is just as secure, and light (especially the ultra-violet) is allowed to permeate to the wounded tissues and especially to the bud which needs the ultra-violet for the metabolic activity of its chlorophyll.

Plant grafting and bone grafting thus have the same objective and are carried out according to the same fundamental principles. The application of these in bone must be more meticulous since there are added difficulties in a relatively highly specialized tissue nourished by a system of closed vessels.

In the plant, the graft and host tissues must be maintained in close apposition; other than this, the only displacing force to be counteracted is that of the wind, and this is only when the scion is a large shoot. In bones, there is danger from the motion of the recipient patient, the pull of muscles, both tonic and voluntary, and the exaggeration of the former by reflex from pain. Fixation and immobilization, therefore, present difficulties which must be met in a special way.

Bancroft's statement in regard to union of fresh fracture is even more applicable to the union of the bone graft: "The most important factor for the union of a fracture is to have the fractured ends in close apposition and to have an adequate blood supply to allow the ingrowth of granulation tissue with the resultant ossification to form callus."

Adequate blood supply and coaptation are even more necessary in the case of the graft applied to chronic cases, because the stimulus to osteogenesis which comes to a recent fracture is lacking in the old fragments. Again, in the fresh fracture, there is usually an adequate supply of blood in marked contrast to the ischemic state of pseudarthrosis. Union of the graft, therefore, proceeds under difficulties that must be counterbalanced by the most careful methods to secure ample blood supply in its application as well as in the method chosen.

VASCULARIZATION AND LIFE OF THE GRAFT

When the writer was in England in 1929, Sir Arthur Keith, the eminent clinical pathologist showed him specimens of grafts inserted for various purposes, which he had obtained from postmortems and injected to demonstrate the marked vascularization which always occurs in a graft that has well taken.

The early and complete vascularization of a graft has been very striking and interesting to the writer since his early animal experimental work in 1909, and he believes it to be one of the underlying causes of the extremely beneficial action of the bone graft, when inlaid in the spine, or through other tuberculous joints, such as the knee, the tarsus, etc. This factor emphasizes the importance of accuracy of fit of the graft to host tissues, and particularly to the vascular portions of them, and also the importance of using a massive graft of ample length, as under such condition the intact, unbroken Haversian canals of the graft very rapidly become canalized and increased in size in precisely the same way as a collateral circulation is established when demands for blood occur for tissue maintenance or repair when blood vessels have been destroyed.

The various layers of a bone graft freshly removed present raw surfaces wherever they have been cut. The vessels are severed but still contain blood which tends to clot at the point of section. The various tissues of the graft are capable of survival for a considerable time, but it is of the first importance to restore its blood supply and nutrition at the earliest possible time. The graft must be placed in the most favorable environment for this end. If it is so placed, the elements of the graft (periosteum, cortex, endosteum and marrow) make direct and intimate contact with similar elements in the host; the soft tissues of the bone first unite across the slight gap; vascular continuity of host and graft is re-established through periosteum, endosteum and marrow, and a granulation tissue bridge is laid

down between the bony surfaces. Osteoblasts appear in the granulation tissue and determine the deposition of lime salts. If the process follows Bancroft's picture of healing bone, the continuity of the Haversian systems will be indirect until the normal architecture has been established between the graft and the host. Under ideal conditions, the greatest possible number of capillaries of host and graft are brought into the closest mutual approximation. The entire graft will then remain intact. If such conditions are not provided, smaller or larger areas of the graft will fail to be nourished and will ultimately be replaced. The process by which the bony structure of the graft is later rearranged to conform to architectural structure of the host is, in no sense, absorption. The process can be called assimilation, if the term is used in the sense that the graft assimilates itself to the host. The graft is not the subject of processes imposed upon it by the host; it is itself the active agent in its own rearrangement under the influence of the stresses which it encounters in its new environment; it has the power of adaptation. The question of whether the bone graft lives, when properly placed in a favorable environment, has been answered positively in the affirmative during the past thirty-five years of personal experience, both in the animal research laboratory and in the clinic, at the operating table and the follow-up of over 6,000 cases. The *x*-ray is by all means the most trustworthy method of study, not even excepting the microscope. With its aid, the welfare and development of a graft over many years may be followed. Both in the case of animal work as well as clinical, if, for any reason, part of a graft becomes dead as from infection, the *x*-ray never fails to disclose it. There could never be any doubt about the continued life of a scion, such as in the apple tree. A scion from a sweet apple tree when grafted into a tree bearing sour apples will always bring forth sweet apples of the exact variety of the tree of the scion's origin. This same phenomenon occurs throughout the vegetable kingdom so long as scions are grafted into one of its own family.

If all the elements of the graft cannot be brought into contact with similar elements of the host, the marrow at least should be. Johnson's conclusion that the circulation in a bone is re-established 75 per cent by the marrow and endosteum, and 25 per cent by the periosteum, indicates the shares which each tissue has in osteogenesis, and the importance of coapting the graft with the marrow, or better, with both endosteal and periosteal side of the bone cortex. (Fig. 8A and B.) It is apparent that the inlay type of graft brings about these desired conditions as no other type does. The blood supply is the key to the situation, as shown by numerous clinical observations.

RELATION TO COAPTION TO UNION

The approximation of graft to host is analogous to closure of a wound in soft tissue. If the opposing surfaces are poorly approximated, much granulation tissue is required to fill the gap and healing is slow. If the surfaces are brought into close contact, the layer of granulation tissue is of small thickness and healing by first intention results. This speedy granulation tissue union not only re-establishes the circulation in the graft at the earliest moment, but results in the deposition of the thinnest possible layer of callus between the bones. This necessitates the least possible rearrangement of the callus trabeculae. It is thus evident that not only the viability of the graft but the promptness and durability of union and the rapidity of assimilation of the graft to the host tissues depend on close approximation of graft to both host bones. In non-union, the surgeon will find that nature has little callus for him and he must make the most of the meager supply; he must draw on mechanical principles to compensate for the meagerness of the physiological reaction.

When a graft containing all four elements is placed in intimate contact with the

same elements in the host, it acts as a vascular and osteogenetic unit; vascular union proceeds along the lines of natural repair and a bridge is placed between the two fragments which calls for the minimal amount of trabecular and vascular readjustment to be taken on the function of the host bone it replaces. If the graft is inserted or attached in any other way, vascular communications are limited and the graft may have to be largely or entirely reconstructed by nature before it assumes the structure suitable to the stresses exerted on it. It is, under such circumstances, that fracture or absorption may occur.

RELATION OF IMMOBILIZATION TO UNION

When soft tissues are uniting, their flexibility minimizes the danger of disruption of the granulations. When such rigid tissue as bone is uniting, the least displacement may tear the granulations and blood vessels, or fracture the soft callus. Hence, the necessity for the most precise and stable immobilization. From the mechanical standpoint, the advantages of "internal" immobilization needs no corroboration. Here again, the inlay graft is superior; it exemplifies the mechanical principle of the slot and key. (Fig. 8A and B.)

When the healing fragments and the graft are thus held in rigid immobility, the granulations and callus are protected not only between graft and host, but between the two host fragments. The stress of maintaining immobility should fall on the graft, and, under this influence, the graft grows in size and strength, and adapts its structure to the stress. Because of its phenomenal adaptation, a graft—the size of a pencil—when inserted to take the place of a portion of the femur, will grow to the dimensions of the host bone and assume a similar structure.

NECESSITY FOR POWER-DRIVEN TOOLS

The entire process of union and the survival of the graft depend on the establishment of vascular connections between the graft and the host fragments. The rapidity of establishment and the degree and permanence of vascularization vary directly with closeness of coaptation and the rigidity of immobilization; these depend largely on accuracy of fit. The necessity for the greatest precision in the mechanical procedures needs no further argument; ideal conditions can be produced in no other way as well as by the use of automatic power-driven tools which can be adjusted to cut, with mathematical exactness, both the graft bed and the graft which is to fill it with a "glass stopper" precision fit. (Fig. 8A and B.) This is true whether the graft has the shape of a peg, screw, wedge, straight or mosaic inlay, etc. Fortunately, all bones are filled with cancellous tissue or marrow and are thus well suited to the inlay technic.

RELATIONSHIP OF MECHANICAL, PHYSIOLOGICAL AND BIOLOGICAL PRINCIPLES

The most unfortunate and the most general misconception of the treatment of non-union is that it is solely a mechanical problem. The idea is inherited from the principles of the treatment of fresh fractures. The traditional methods are based entirely on mechanics: how to overcome distorting forces and how to maintain alignment by the application of counter forces or stress.

If, after reasonable reduction and ample immobilization of the fragments, union fails, the problem passes from the realm of pure mechanics into those of physiology and biology. It is not to be expected that repetition of mechanical methods will be successful, since the stimulus to repair, to granulation and ossification has abated. Even in the open treatment of non-union, this faulty conception is frequently evident. Methods are commonly practiced which have no other basis. And there are surgeons who apparently believe that two pieces of bone must unite if held together and that the method of approximation, and means of maintaining them and availability of

blood supply have no bearing on the success of the operation.

In one case that came under my observation, the surgeon had begun by plating the fragments. When failure by this method was evident in due course, he used wire; after another disappointment, he resorted to nails. The third failure did not, by any means, shake his confidence in purely mechanical means. With a persistence, worthy of better cause, he put all three back at a fourth operation, plates, wire and nails. Four times over a period of three and one-half years did he try to find a mechanical antidote for the particular case. He did not fail for lack of skill as the wound healed each time by first intension; if applied to a piece of furniture, his repair would have outlasted the original.

I have tried to trace the reparative processes following the introduction of the bone graft, from the formation of granulation tissue to the incorporation of the graft as an integral part of the host tissue. We know that all tissue reacts to changes in environment. A fractured bone manifests the greatest reparative power during the period immediately following the injury. Since injury thus stimulates repair, it is clear that the freshly removed graft has potentialities for repair that will become fully manifest as soon as it can establish its vascular connections. This reaction to environment takes the form of increased metabolism. As the graft takes on its function of immobilization, its metabolism is further stimulated by the demands of its environment. The adaptive response is increased in size and strength, and this is just what occurs. Thus function determines structure and modification of function brings about modification of structure.

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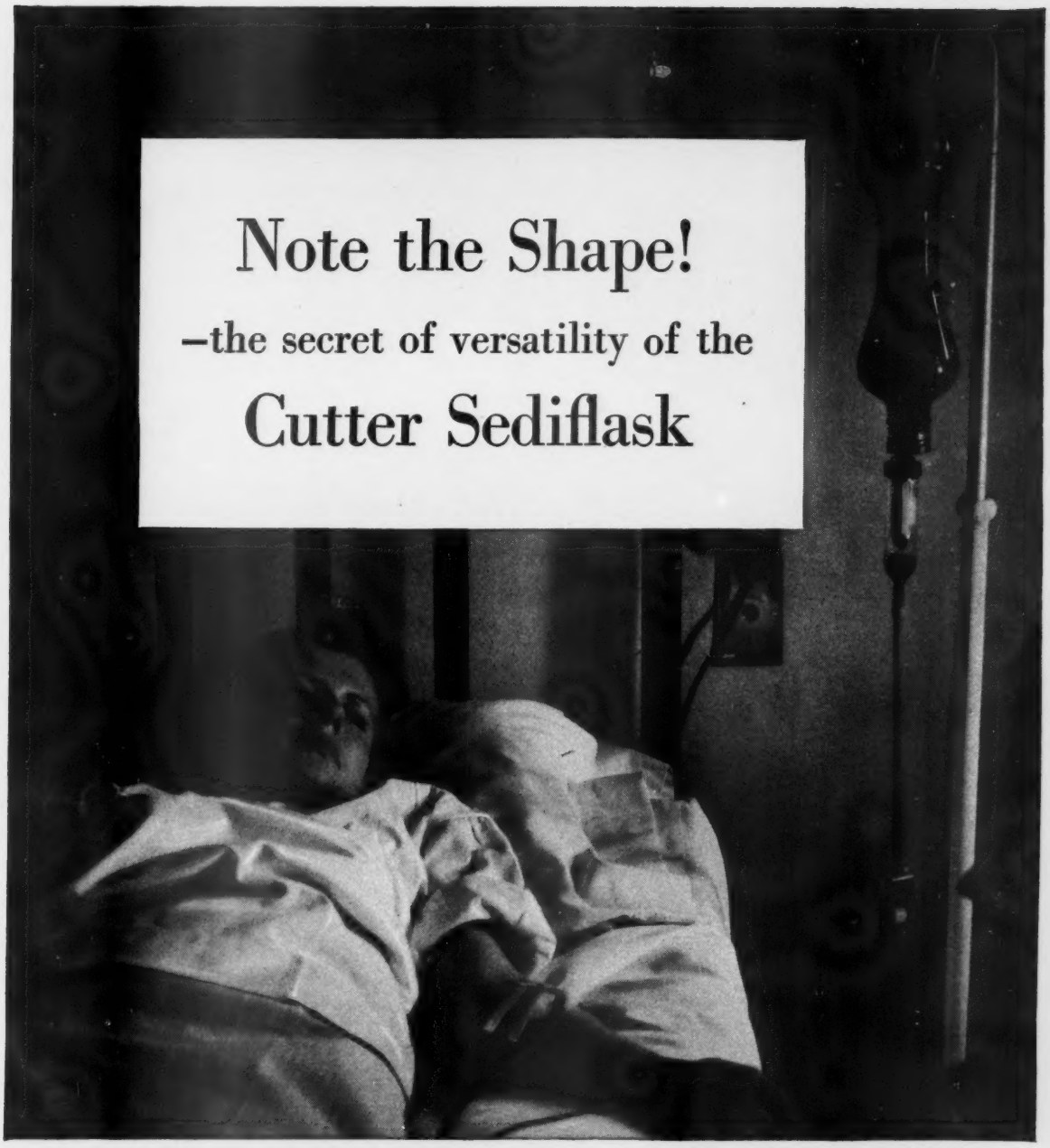

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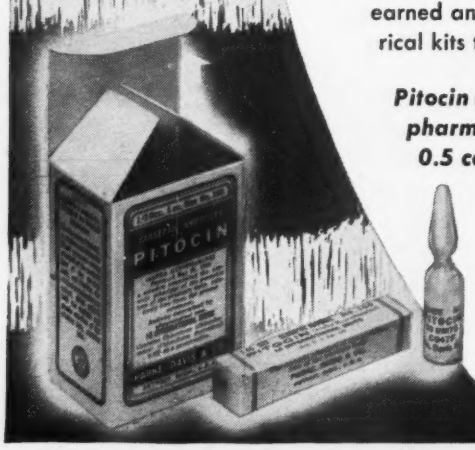

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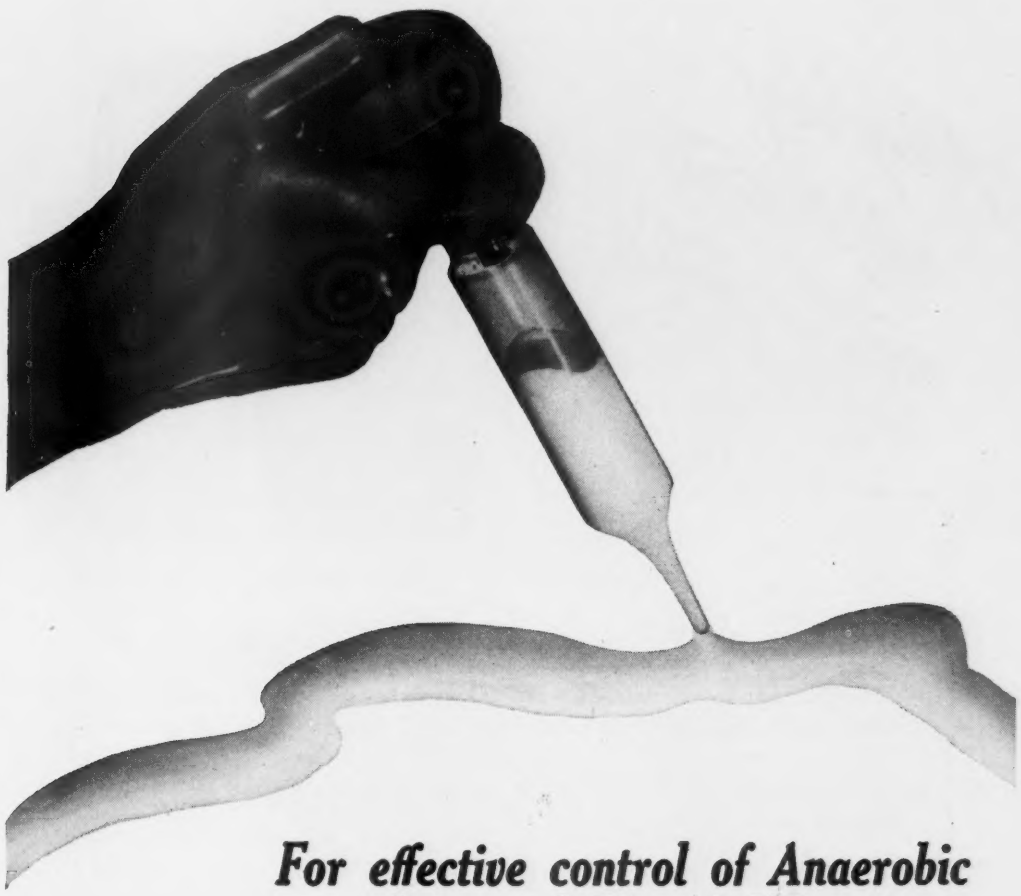

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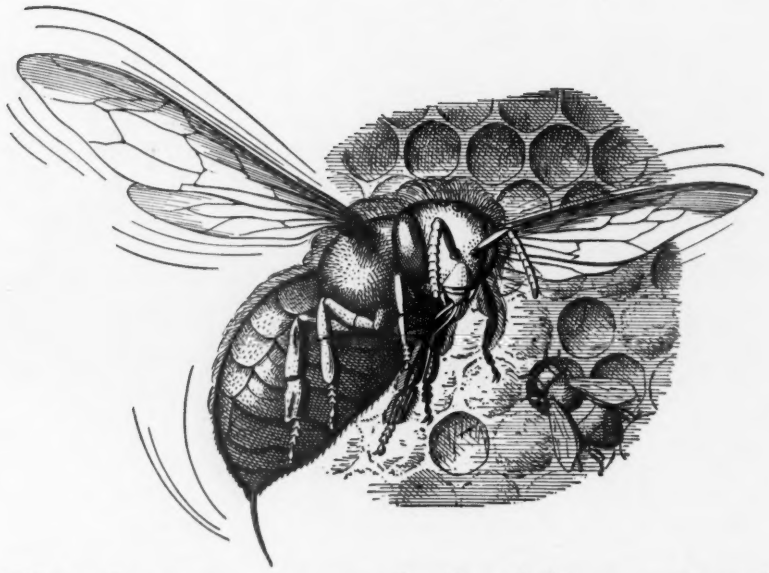

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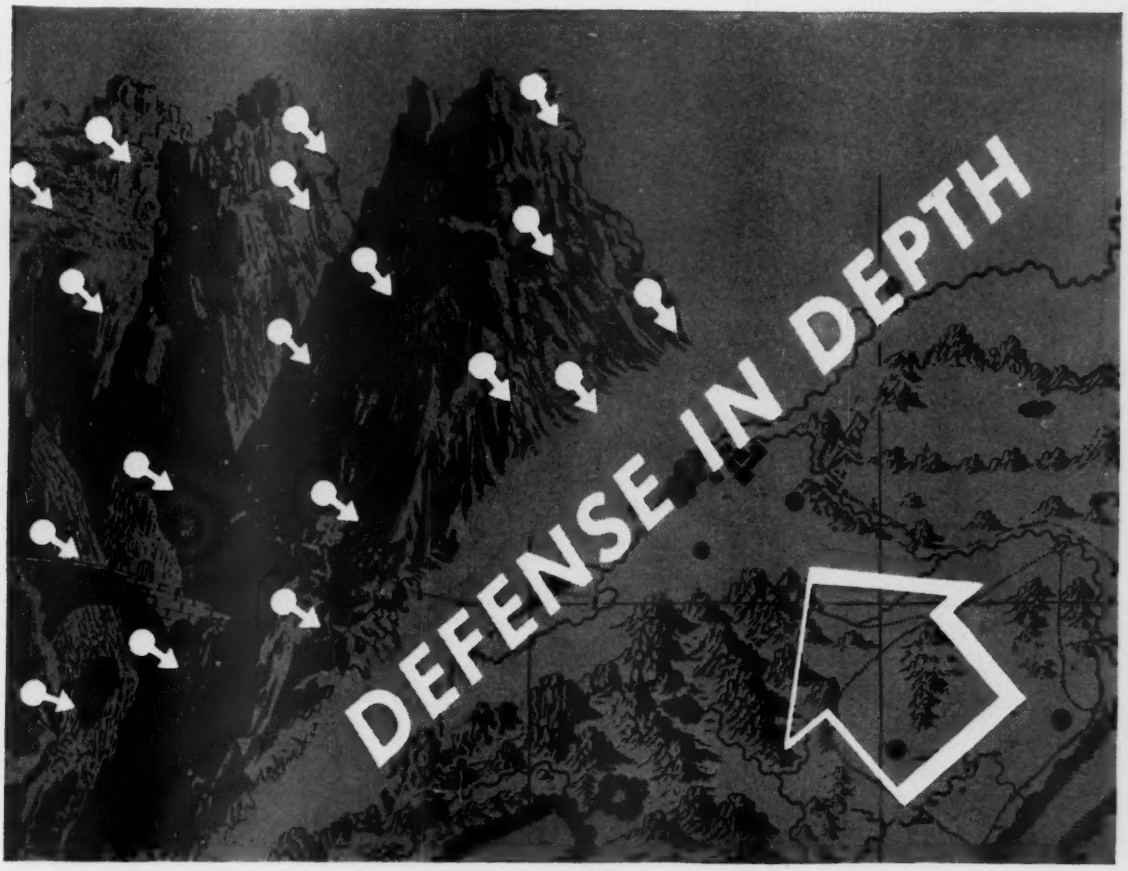

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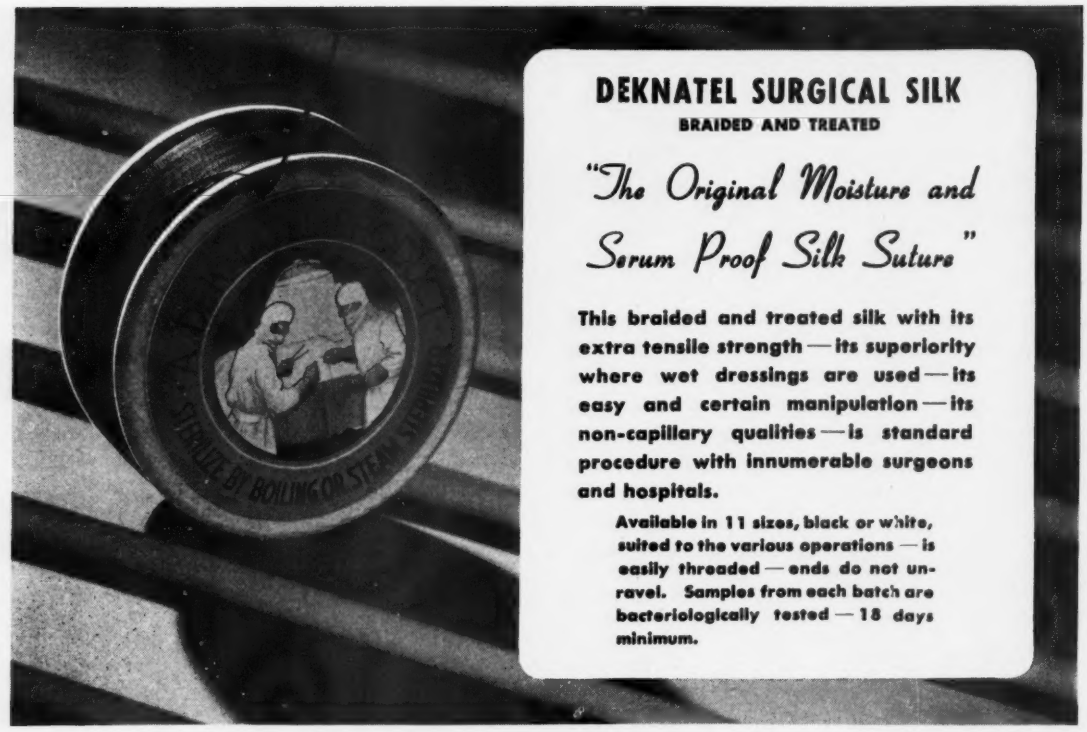

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*Drs. Frederick H. Falls, George H. Rezek and S. T. Benensohn, Surgery, Gynecology and Obstetrics, September, 1942, Vol. 75, pp. 289-299.

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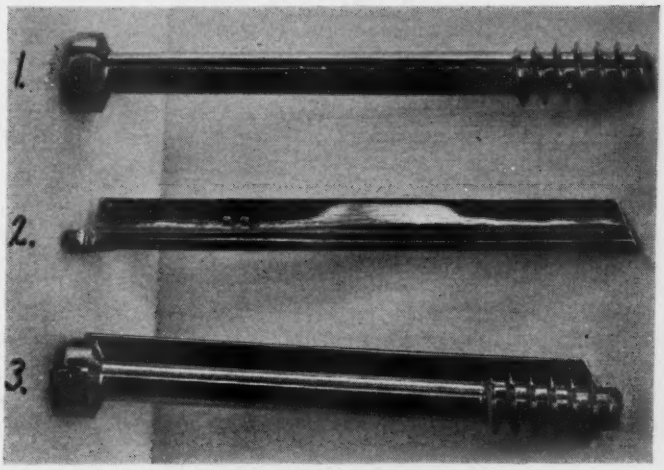

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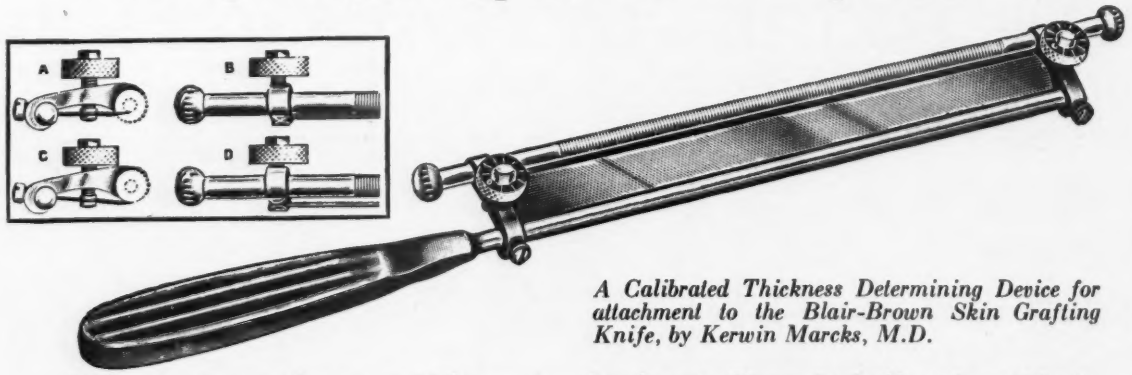

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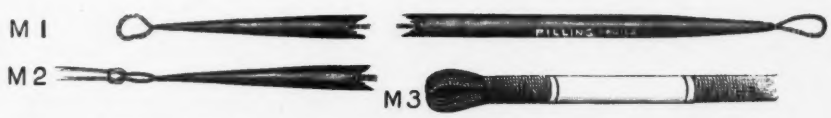

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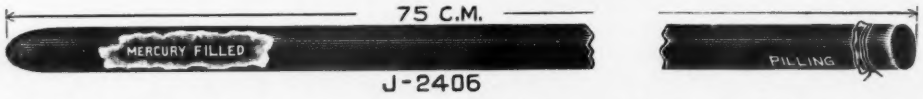

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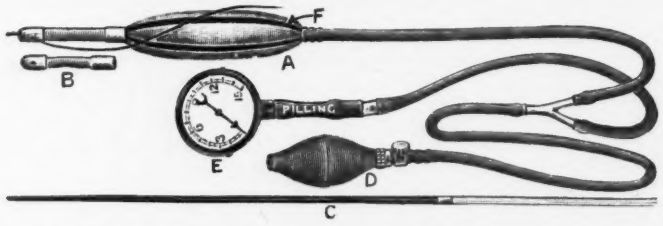

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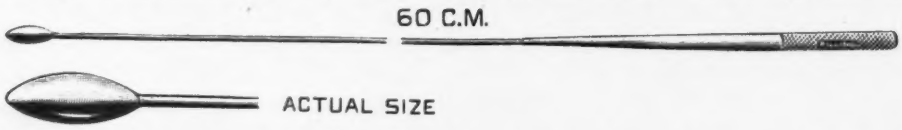

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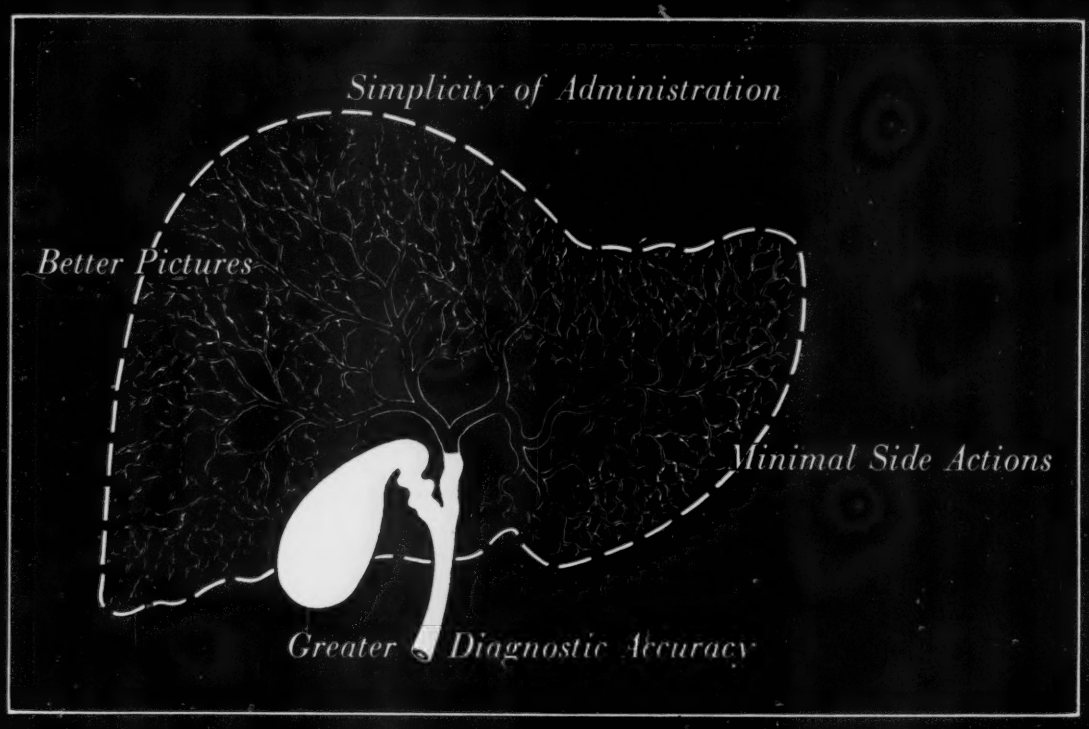

PRIODAX is not related to phenolphthalein: and because of its unique chemical composition it rarely produces vomiting. Excretion of most of the compound by the kidney reduces the possibility of diarrhea.

Literature on request

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The Treasury Department acknowledges with appreciation the publication of this message by

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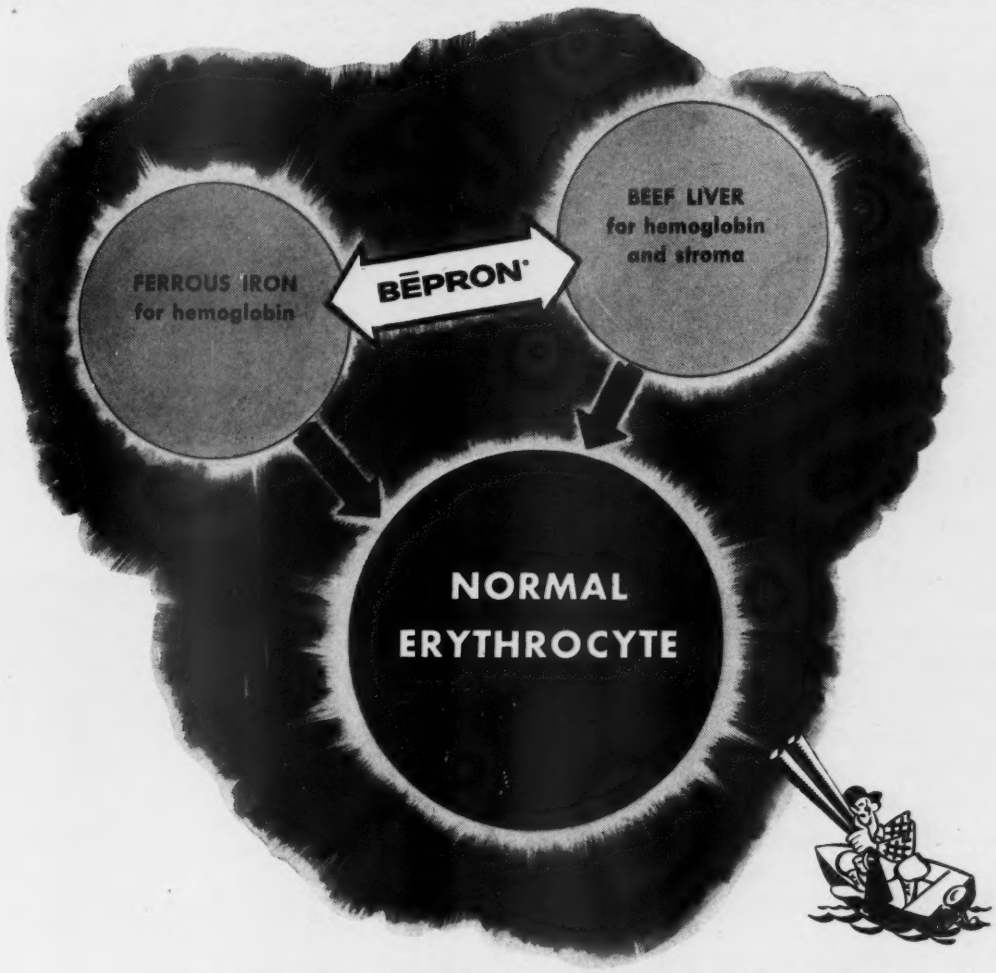

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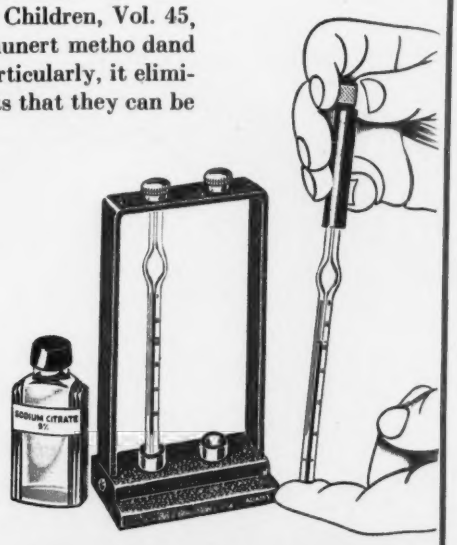

PROCEDURE . . .

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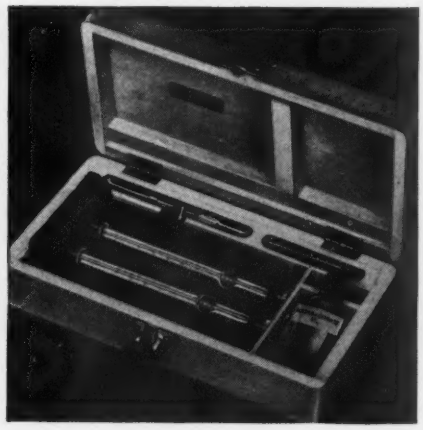

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*Tom D. Spies: Texas State Jl. of Med.: Nov. 1942

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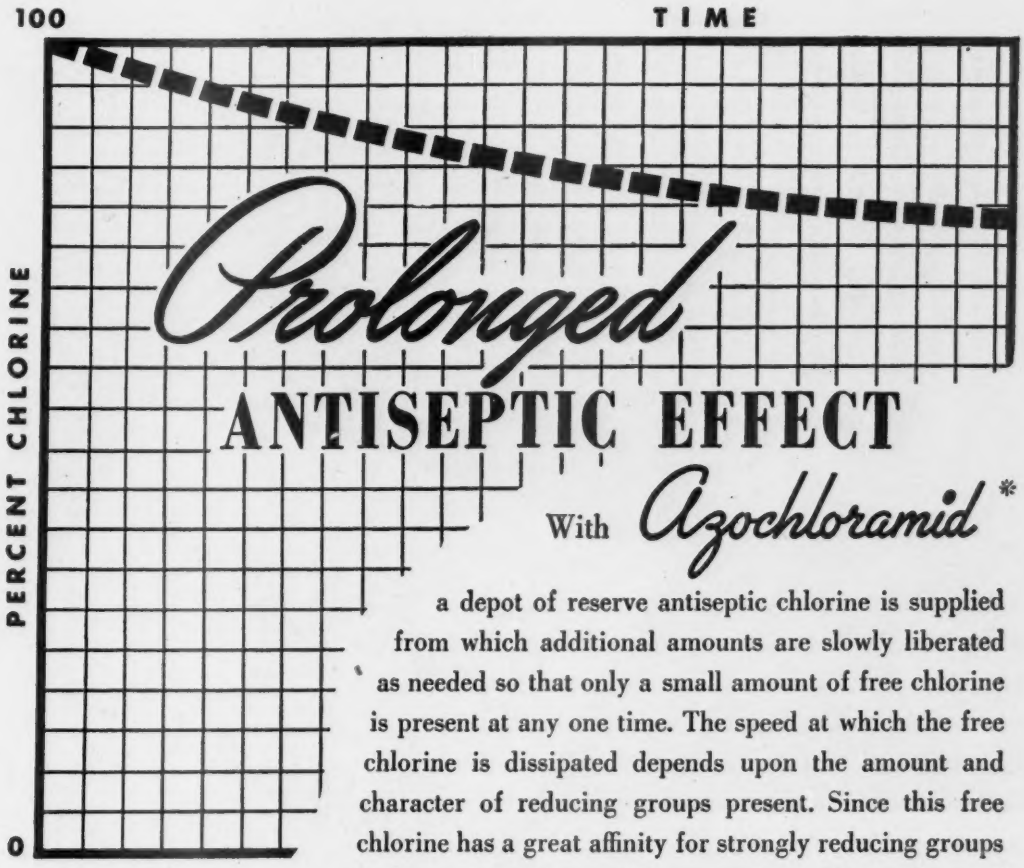

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